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Fairchild Semiconductor Transistor and Diode Data Catalog 1970

The Fairchild Semiconductor Transistor and Diode Data Catalog is an all-inclusive volume of product information covering diodes and transistors. Selection guides and data sheets for each category of products assist you in determining the exact Fairchild device for your needs. Also included: a complete listing of application notes and technical papers, ordering information, and reply cards.

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HOW TO USE THE DATA CATALOG

The Fairchild Semiconductor Transistor and Diode Data Catalog is divided into sections by product category. Each section contains selection guides, numerical indices, and data sheets. Product categories are listed in the Table of Contents on page iii and include: Switching, General Purpose, and RF Metal Can Transistors, Power Transistors, SCR's, Special Transistor Products, and Electro-Optical Devices. Within these categories products are classified according to function: switches, amplifiers, etc. The various classifications are clearly indicated in the Table of Contents.

Comprehensive listings including device type and page number are provided on pages 1-1 through 1-10. Here you will find all the transistors, diodes, and radiation resistant devices indexed. Also included in this section is a list of military-approved transistors and diodes.

In addition to the comprehensive indices beginning on page 1-1, a numerical index for each section is located on the first page of each section. For instance, the numerical index for all Special Transistor Products is located on the first page of the Special Products section, 7-i.

Selection Guides are provided at the beginning of each main section to simplify the selection of those devices which would be most useful for a particular application. These selection guides narrow the broad categories of potential components to those best suited for a certain application. After choosing the desired devices, simply refer to the numerical index immediately following each selection guide for page numbers of data sheet specifications.

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Switching, General Purpose, and RF Transistors (Metal Can)

High Speed Switches
General Purpose Amplifiers
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2N4028	2-263	SE5021	2-307	SE8001	2-360
2N4029	2-263	2N5022	2-311	SE8002	2-360
2N4030	2-267	SE5022	2-307	SE8010	2-361
2N4031	2-267	2N5023	2-311	SE8041	2-363
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HIGH SPEED SWITCH SELECTION GUIDE

Rated V_{CEO} Volts	Optimum Collector Current mA									
	0.1 —	50	10 —	100	100 —	300	300 —	500	500 —	1000
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
6	FT709 2N4251*	2N4207	FT709 2N3010	2N4207						
12	2N3011	2N4208 2N3012 2N4872* 2N5292* 2N2894A	2N3011	2N4208 2N3012 2N2894A 2N4872* 2N5292*	2N3426 2N3303 2N5065*	2N3012 2N2894A	2N3426 2N3303 2N5065*		2N3426 2N3303 2N5065*	
15	2N2369A 2N4873*	2N4209 2N5056 2N5057	2N2369A 2N3009 2N3013 2N914 2N4873*	2N4209 2N5056 2N5057	2N3009 2N3013 2N3646 2N914	2N5056 2N5057	2N3013 2N914			
20-25	2N4137	2N3209 2N2927 2N2695, 6	2N4137 2N3014 2N2847 2N2848	2N3209 2N2927 2N2695, 6	2N3014 2N2847 2N2848	2N3209 2N2927 2N2695, 6	2N3014 2N2847 2N2848			
30-45	2N3299 2N3300 2N3301 2N3302 2N5106* 2N5107*	2N4034 2N2904-7 2N3120, 1 2N3502, 4	2N3299 2N3300 2N3301 2N3302 2N2845 2N2846 2N3015 2N4013 2N3724 2N4046 2N5144*, 5* 2N5106*, 7*	2N5023 2N4034 2N2904-7 2N3120, 1 2N3467 2N3502, 4	2N3299 2N3300 2N3301 2N3302 2N2845 2N2846 2N3015 2N4013 2N3724 2N4046 2N5106*, 7* 2N5144*, 5*	2N5023 2N2904-7 2N3120, 1 2N3467 2N3502, 4	2N3299 2N3300 2N3301 2N3302 2N2845 2N2846 2N3015 2N4013 2N3724 2N4046 2N5106*, 7* 2N5144*, 5*	2N5023 2N3467	2N4013 2N3724 2N4046 2N5144* 2N5145*	2N5023 2N3467
45-60		2N3072, 3 2N3503, 5 S18000	2N3722 2N4014 2N3725 2N4047	2N5022 2N3072, 3 2N3503, 5 S18000	2N3722 2N4014 2N3725 2N4047	2N5022 2N3072, 3 2N3503, 5 S18000	2N3722 2N4014 2N3725 2N4047	2N5022	2N3722 2N4014 2N3725 2N4047	2N5022
80			2N3723		2N3723		2N3723		2N3723	

*Radiation Resistant devices

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GENERAL PURPOSE AMPLIFIER AND SWITCH SELECTION GUIDE

Rated V_{CEO} Volts	Optimum Collector Current mA 0.10 — 50 NPN	 PNP	 10 — 100 NPN	 PNP	 100 — 300 NPN	 PNP	 300 — 500 NPN	 PNP	 500 — 1000 NPN	 PNP
10-20	2N4251* 2N5200* 2N5201*		2N4251*							
25-30	FT107A 2N3299-3302 2N5106*, 07*	2N2695, 96 2N2927	2N3299-3302 2N5106*, 07* SE8041, 42	2N7695, 96 2N2927	2N3299-3302 2N5106*, 07* SE8041, 42	2N2695, 96* 2N2927	2N3299-3302 2N5106*, 07* SE8041, 42		SE8041, 42	
40-45	FT107B 2N3109, 10 2N3642	2N4034, 35 2N3964 2N4359 2N5244*	2N3109, 10	2N3120, 21 2N3504, 02 2N5042 2N2904-07 2N5244*	2N3109, 10	2N3120, 21 2N3504, 02 2N5042 2N2904-07	2N3109, 10	2N3504, 02 2N5042	2N3109, 10	2N5042
60	FT107C 2N2483, 84 2N4960, 62	2N3962 2N3965 2N4359 2N4026, 28 2N4030, 32	2N3107, 08 2N4960, 62	2N3505, 03 2N4026, 28 2N4030, 32 2N3072, 73	2N3107, 08 2N4960, 62	2N3505, 03 2N4026, 28 2N4030, 32 2N3072, 73	2N3107, 08 2N4960, 62	2N3505, 03 2N4026, 28 2N4030, 32	2N3107, 08	2N4026, 28 2N4030, 32
80	2N4961, 63	2N3963 2N4027, 29 2N4031, 33	2N4961, 63	2N4027, 29 2N4031, 33	2N4961, 63	2N4027, 29 2N4031, 33	2N4961, 63	2N4027, 29 2N4031, 33		2N4027, 29 2N4031, 33
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450		SE7057		SE7057						

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RF/IF AMPLIFIER SELECTION GUIDE

f MHz	Polarity	Device	Power Gain dB (min)	@	f MHz	NF dB (max)	@	f MHz	C_{cb} pF (max)
27	NPN	SE8010	10.8		27				9.0
45	NPN	SE5055	27		45	5.0		45	0.22
60	NPN	2N4134	17		60	2.5		60	0.50
100	PNP	2N4034	25 typ		100	6.0		100	3.5
	PNP	2N5244*	25 typ		100	6.0		100	3.5
	NPN	SE5050	20		100	4.0		100	0.5
200	NPN	2N918	15		200	6.0		60	1.7
	NPN	2N2616	15		200	6.0		60	2.8
	NPN	SE5020	20		200	3.3		200	0.5
250	NPN	2N3137	6		250				3.5
	NPN	2N5236*	6		250				3.5
450	NPN	2N4135	8		450	5.0		450	0.5

*Radiation Resistant Devices

RF/IF OSCILLATOR SELECTION GUIDE

f MHz	Polarity	Device	OSC P_O mW (min)	@	I_C mA
100	PNP	2N4034	200 typ		10
	PNP	2N5244*	200 typ		10
500	NPN	2N918	30		8
	NPN	2N2616	30		8
	PNP	2N4208	10 typ		10
	PNP	2N4872*	10 typ		10
1000	NPN	FT17	35		15

*Radiation Resistant devices

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FT107A • SE4022

NPN LOW LEVEL, LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

LOW 1/f NOISE . . . . **NF = 8.0 dB (MAX) AT 10 Hz, 1.0 kΩ**
HIGH GAIN . . . . **h_{FE} = 900 (MIN) AT 10 μA**
h_{FE} = 1200 (MIN) AT 10 mA
LOW SATURATION VOLTAGE . . . **$V_{CE(sat)}$ = 0.2 V (MAX) AT 10 mA/0.5 mA**
LOW LEAKAGE . . . . **I_{CBO} = 2.0 nA (MAX) AT V_{CB} = 20 V**
I_{CBO} = 50 nA (MAX) AT V_{CB} = 20 V, T_A = 65°C (SE4022)
I_{CBO} = 1.0 μA (MAX) AT V_{CB} = 20 V, T_A = 125°C (FT107A)

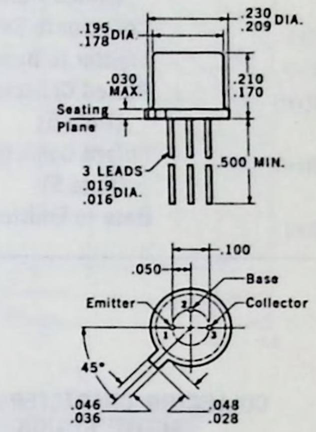
BSOLUTE MAXIMUM RATINGS (Note 1)

		FT107A	SE4022
Maximum Temperatures			
Storage Temperatures		−65°C to +150°C	−65°C to +125°C
Operating Junction Temperatures		+150°C	+125°C
Lead Temperature (Soldering, 10 seconds time limit)		+300°C	+260°C
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		0.86 Watt	0.5 Watt
25°C Ambient Temperature		0.26 Watt	0.2 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	30 Volts	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	30 Volts
V_{EBO}	Emitter to Base Voltage	8.0 Volts	8.0 Volts
I_C	Continuous Collector Current	50 mA	50 mA

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
NF	Narrow Band Noise Figure (f = 1.0 kHz)		4.0	6.0	dB	I_C = 100 μA R_S = 1.0 kΩ	V_{CE} = 5.0 V BW = 400 Hz
NF	Narrow Band Noise Figure (f = 1.0 kHz)		1.0	3.0	dB	I_C = 100 μA R_S = 10 kΩ	V_{CE} = 5.0 V BW = 400 Hz
NF	Narrow Band Noise Figure (f = 1.0 kHz)		2.0	6.0	dB	I_C = 100 μA R_S = 100 kΩ	V_{CE} = 5.0 V BW = 400 Hz
NF	**Narrow Band Noise Figure (f = 10 Hz)**		**5.0**	**8.0**	**dB**	**I_C 100 μA** **R_S = 1.0 kΩ**	**V_{CE} = 5.0 V** **BW = 10 Hz**
h_{FE}	**DC Current Gain**	**900**	**1100**			**I_C = 10 μA**	**V_{CE} = 5.0 V**
h_{FE}	DC Current Gain	1000	1580			I_C = 100 μA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	1200	1735			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**1200**	**1540**	**2200**		**I_C = 10 mA**	**V_{CE} = 5.0 V**
h_{FE}(−55°C)	DC Current Gain	300				I_C = 10 μA	V_{CE} = 5.0 V
h_{FE}(100°C)	DC Pulse Current Gain (Note 5) (FT107A)		2140	3300		I_C = 10 mA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0	2.8			I_C = 10 mA	V_{CE} = 5.0 V

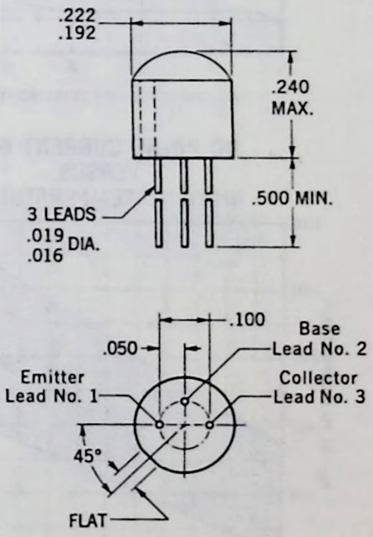
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

FT107A

PHYSICAL DIMENSIONS
in accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

SE4022

*Planar is a patented Fairchild process.

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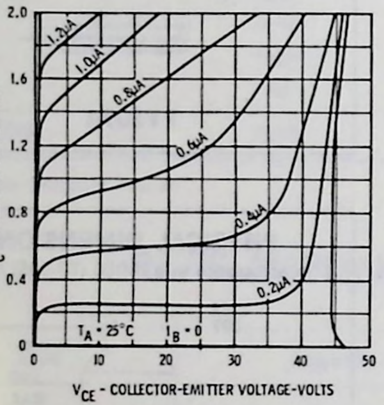
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

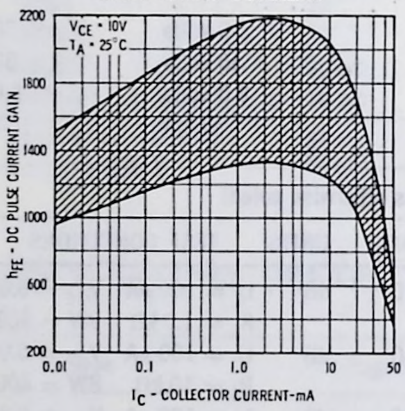
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	**Collector Cutoff Current**		0.02	2.0	nA	$I_E = 0$	$V_{CB} = 20$ V
I_{CBO}(65°C)	**Collector Cutoff Current (SE4022)**		0.3	50	nA	$I_E = 0$	$V_{CB} = 20$ V
I_{CBO}(125°C)	**Collector Cutoff Current (FT107A)**		0.02	1.0	μA	$I_E = 0$	$V_{CB} = 20$ V
I_{EBO}	Emitter Cutoff Current		0.03	1.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{cb}	Collector Base Capacitance		2.5	4.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter Base Capacitance		2.9	6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			Volts	$I_C = 5.0$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	30			Volts	$I_C = 10$ μA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0			Volts	$I_C = 0$	$I_E = 10$ μA
$V_{CE(sat)}$	**Pulsed Collector to Emitter Saturation Voltage (Note 5)**		0.085	0.2	Volt	$I_C = 10$ mA	$I_B = 0.5$ mA
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		0.14	0.3	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(on)}$	Base to Emitter On Voltage		0.6	0.7	Volt	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

TYPICAL ELECTRICAL CHARACTERISTICS

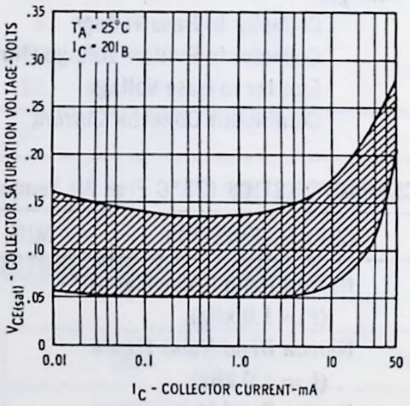
COLLECTOR CHARACTERISTICS* ACTIVE REGION



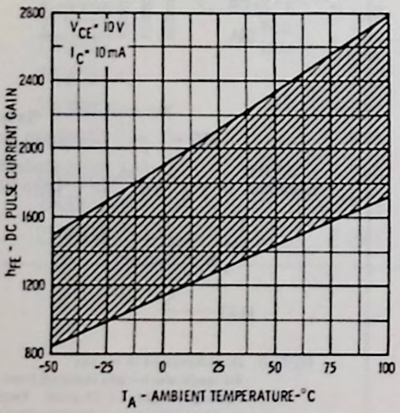
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT**



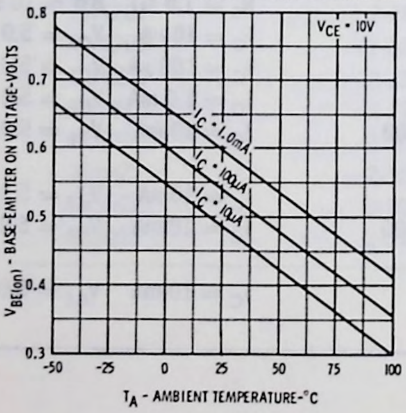
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT**



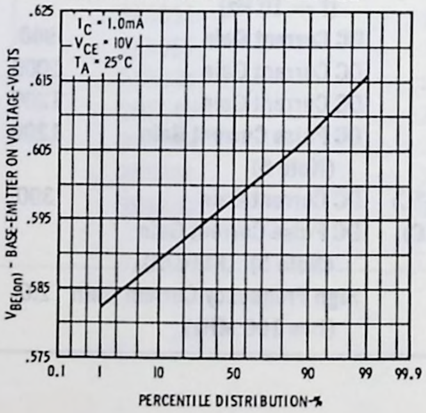
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE**



BASE-EMITTER ON VOLTAGE VERSUS AMBIENT TEMPERATURE



DISTRIBUTION OF BASE-EMITTER ON VOLTAGE**



* Single family characteristics on Transistor Curve Tracer.

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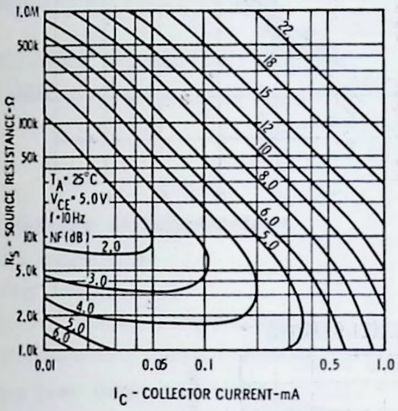
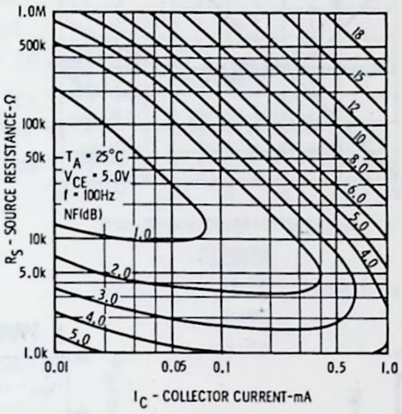
TYPICAL ELECTRICAL CHARACTERISTICS

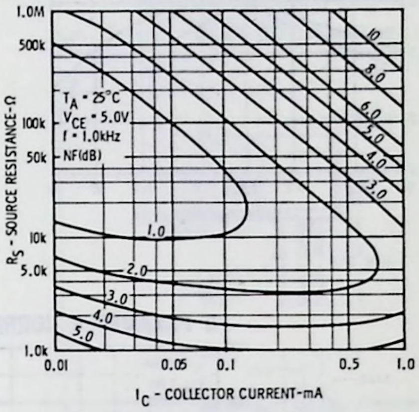
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



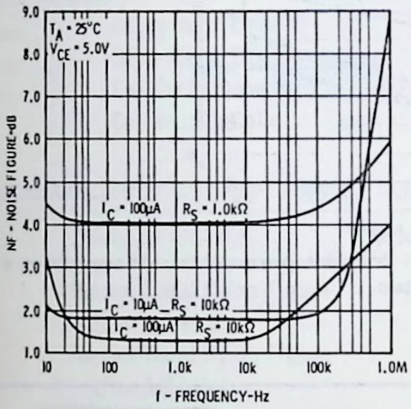
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



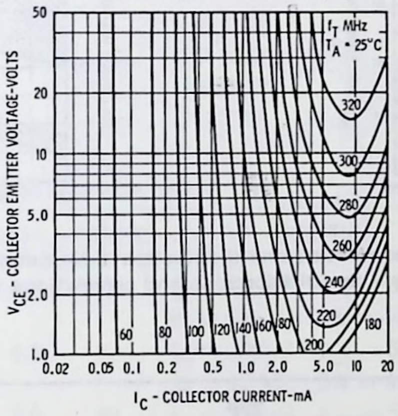
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



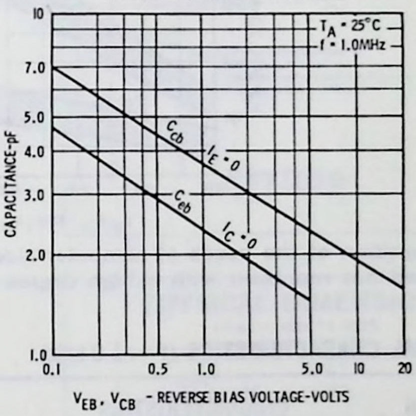
NOISE FIGURE VERSUS FREQUENCY



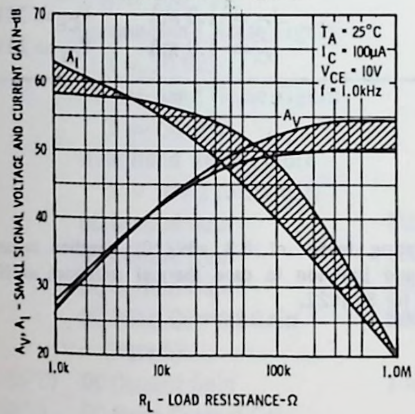
CONTOURS OF CONSTANT GAIN BANDWITH PRODUCT (f_T)



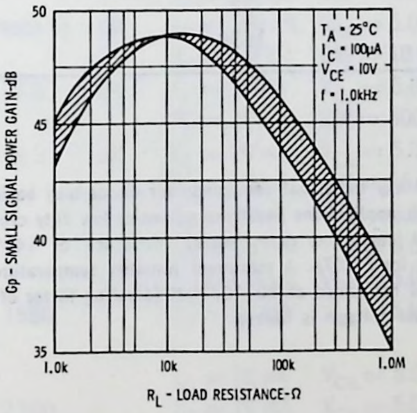
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



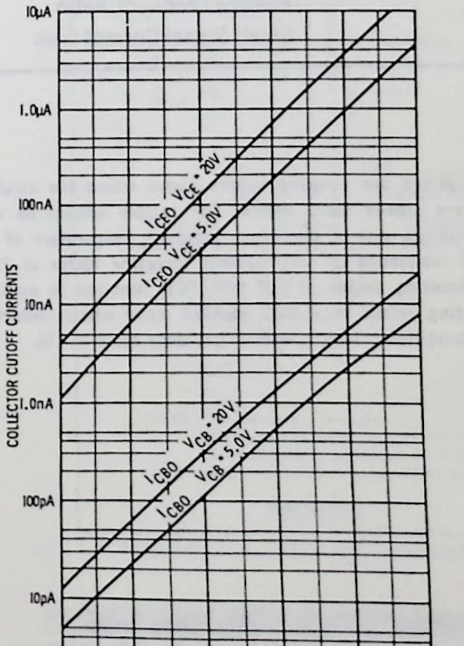
SMALL SIGNAL VOLTAGE AND CURRENT GAIN VERSUS LOAD RESISTANCE**



SMALL SIGNAL POWER GAIN VERSUS LOAD RESISTANCE**



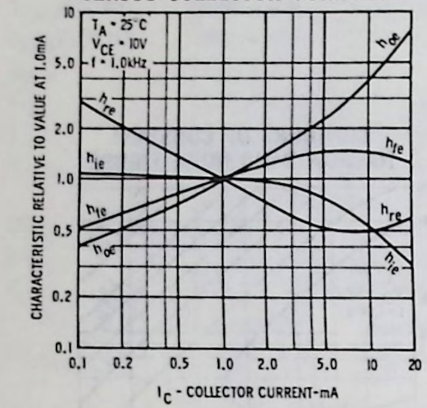
COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



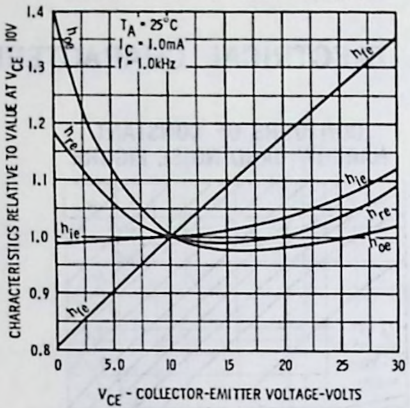
*** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

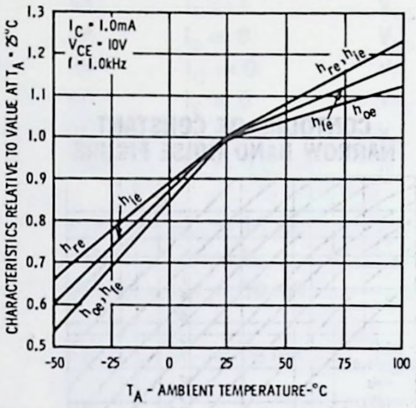
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



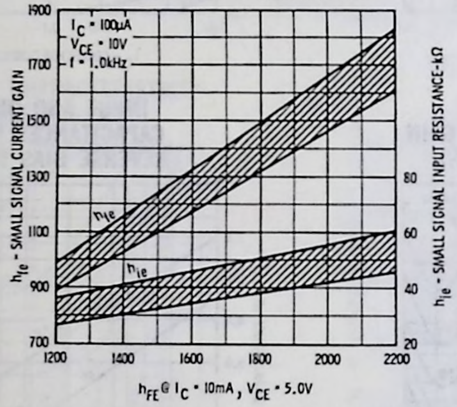
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



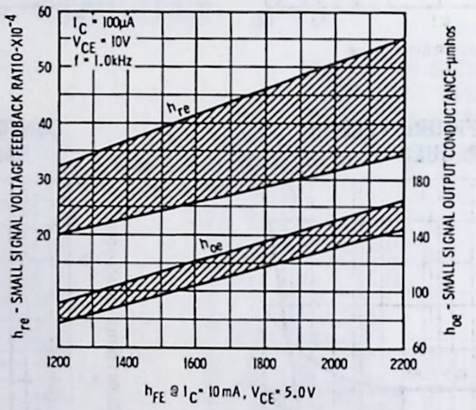
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



h PARAMETER CORRELATIONS**



h PARAMETER CORRELATIONS**



** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	39	kohms	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{oe}	Output Conductance	120	µmhos	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{re}	Voltage Feedback Ratio	33	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain	1630		$I_C = 1.0$ mA	$V_{CE} = 10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction to ambient thermal resistance of 480°C/Watt (derating factor of 2.1 mW/°C) for FT107A. A maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 5.0 mW/°C) for SE4022.
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 µs; duty cycle = 1%.

FT107B · SE4021

NPN LOW LEVEL, LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

LOW 1/f NOISE . . . . NF = 6.0 dB (TYP) AT 10 Hz, 1.0 kΩ
HIGH GAIN . . . . h_{FE} = 450 (MIN) AT 10 μA
h_{FE} = 600 (MIN) AT 10 mA
LOW SATURATION VOLTAGE . . . $V_{CE(sat)}$ = 0.2 V (MAX) AT 10 mA/0.5 mA
LOW LEAKAGE . . . . I_{CBO} = 2.0 nA (MAX) AT V_{CB} = 30 V
I_{CBO} = 50 nA (MAX) AT V_{CB} = 30 V, T_A = 65°C (SE4021)
I_{CBO} = 1.0 μA (MAX) AT V_{CB} = 30 V, T_A = 125°C (FT107B)

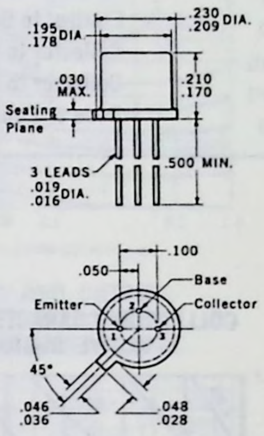
SOLUTE MAXIMUM RATINGS (Note 1)

		FT107B	SE4021
Maximum Temperatures		**FT107B**	**SE4021**
Storage Temperatures		−65°C to +150°C	−65°C to +125°C
Operating Junction Temperatures		+150°C	+125°C
Lead Temperature (Soldering, 10 seconds time limit)		+300°C	+260°C
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		0.86 Watt	0.5 Watt
25°C Ambient Temperature		0.26 Watt	0.2 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	45 Volts	45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts	45 Volts
V_{EBO}	Emitter to Base Voltage	8.0 Volts	8.0 Volts
I_C	Continuous Collector Current	50 mA	50 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		3.5	6.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 1.0 kΩ BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		1.5	4.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 10 kΩ BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		2.5	8.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 100 kΩ BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 100 Hz)		3.5			I_C = 100 μA V_{CE} = 5.0 V R_S = 1.0 kΩ BW = 8.0 Hz
NF	**Narrow-Band Noise Figure (f = 10 Hz)**		**6.0**	(Note 6)	**dB**	**I_C = 100 μA V_{CE} = 5.0 V** **R_S = 1.0 kΩ BW = 10 Hz**
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		1.5	3.0	dB	I_C = 10 μA V_{CE} = 5.0 V R_S = 10 kΩ BW = 400 Hz
NF	Wide-Band Noise Figure (f = 10 Hz to 10 kHz)		1.5	3.0	dB	I_C = 10 μA V_{CE} = 5.0 V R_S = 10 kΩ BW = 15.7 kHz
FE	**DC Current Gain**	**450**	735			**I_C = 10 μA V_{CE} = 5.0 V**
FE	DC Current Gain	500	840			I_C = 100 μA V_{CE} = 5.0 V
FE	DC Current Gain	550	960			I_C = 1.0 mA V_{CE} = 5.0 V
FE	**DC Pulse Current Gain** (Note 5)	**600**	**950**	**1550**		**I_C = 10 mA V_{CE} = 5.0 V**
FE(−55°C)	DC Current Gain	130				I_C = 10 μA V_{CE} = 5.0 V
FE(100°C)	DC Pulse Current Gain (FT107B) (Note 5)		1200	2300		I_C = 10 mA V_{CE} = 5.0 V
e	High Frequency Current Gain (f = 100 MHz)	1.5	2.6			I_C = 10 mA V_{CE} = 5.0 V

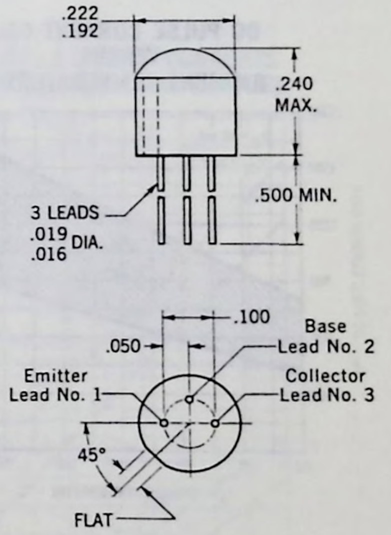
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

FT107B

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

SE4021

*Planar is a patented Fairchild process.

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

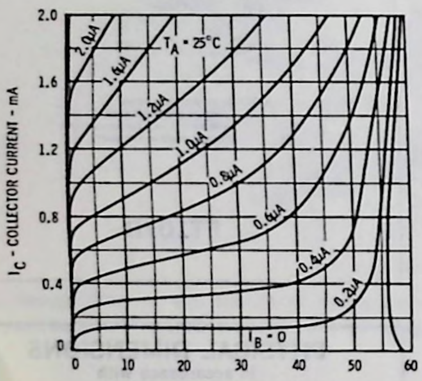
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

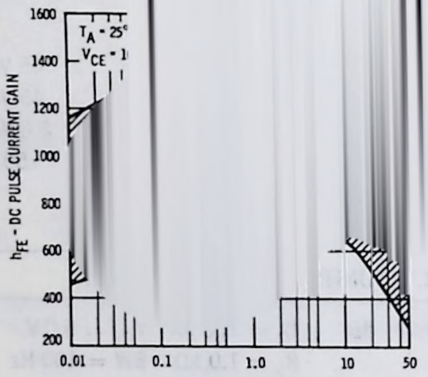
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	**Collector Cutoff Current**		**0.1**	**2.0**	**nA**	**$I_E = 0$**	**$V_{CB} = 30$ V**
I_{CBO}(65°C)	**Collector Cutoff Current (SE4021)**		**1.0**	**50**	**nA**	**$I_E = 0$**	**$V_{CB} = 30$ V**
I_{CBO}(125°C)	**Collector Cutoff Current (FT107B)**		**0.07**	**1.0**	**μA**	**$I_E = 0$**	**$V_{CB} = 30$ V**
I_{EBO}	Emitter Cutoff Current		0.005	1.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{cb}	Collector to Base Capacitance		2.5	4.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter to Base Capacitance		3.5	6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	45			Volts	$I_C = 5.0$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	45			Volts	$I_C = 10\ \mu$A	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0			Volts	$I_C = 0$	$I_E = 10\ \mu$A
$V_{CE(sat)}$	**Collector to Emitter Saturation Voltage (Note 5)**		**0.12**	**0.2**	**Volt**	**$I_C = 10$ mA**	**$I_B = 0.5$ mA**
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.18	0.3	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(on)}$	Base to Emitter On Voltage		0.62	0.7	Volt	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

TYPICAL ELECT TERISTICS

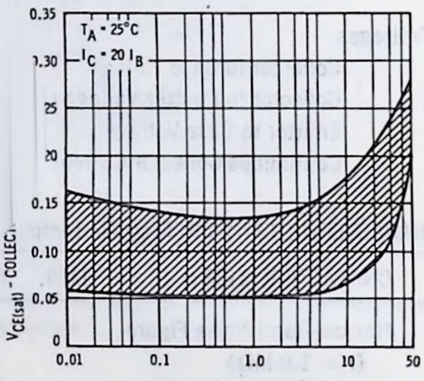
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



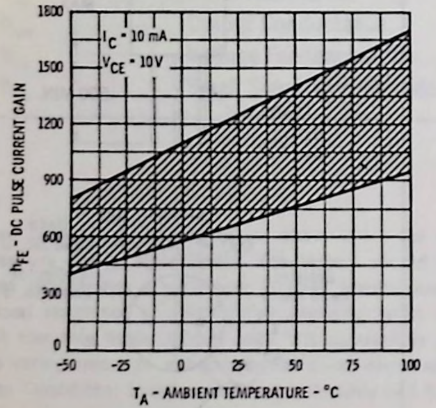
DC
VERSU



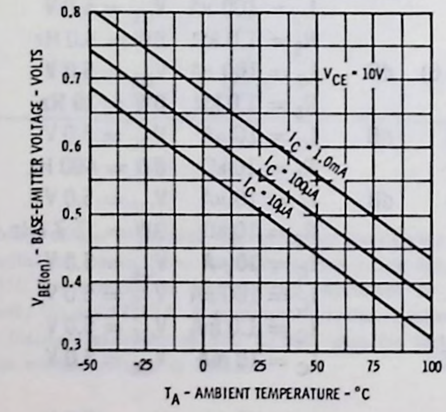
COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT**



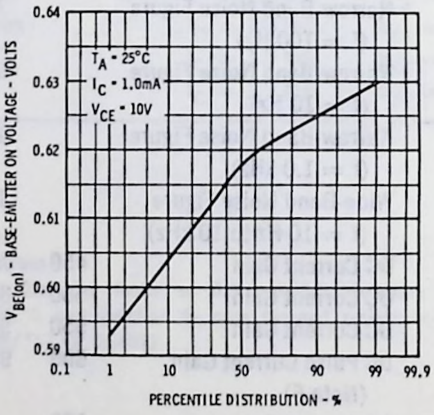
DC PULSE CURRENT GAIN
VERSUS
AMBIENT TEMPERATURE**



BASE-EMITTER ON VOLTAGE
VERSUS AMBIENT TEMPERATURE



DISTRIBUTION OF
BASE-EMITTER ON VOLTAGE**

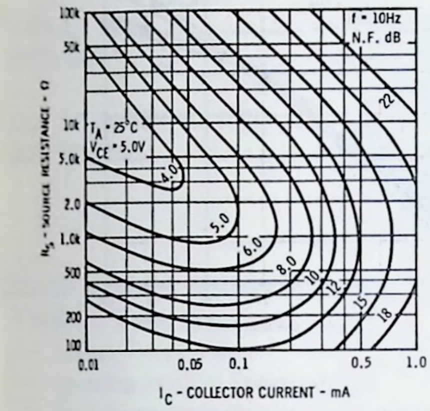


** Single family characteristics on Curve Tracer.*

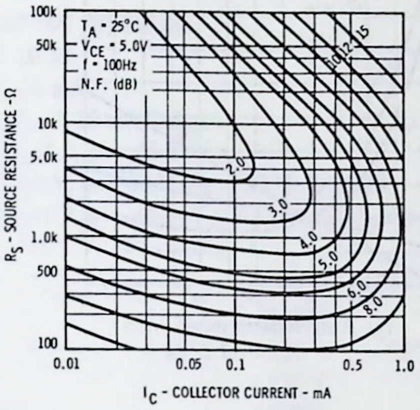
*** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.*

TYPICAL ELECTRICAL CHARACTERISTICS

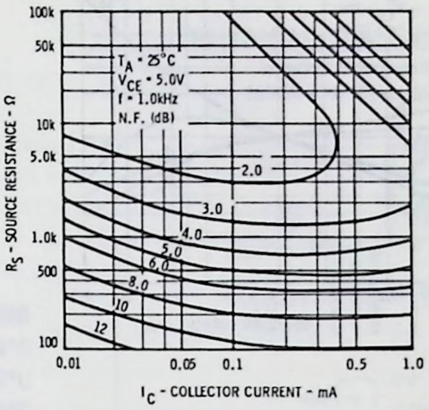
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



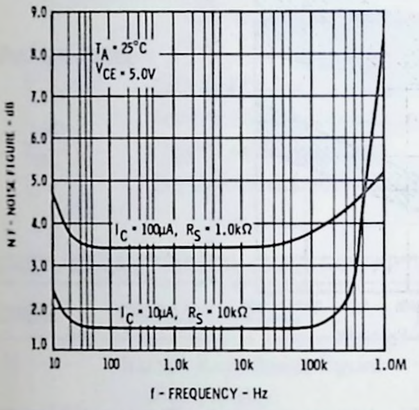
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



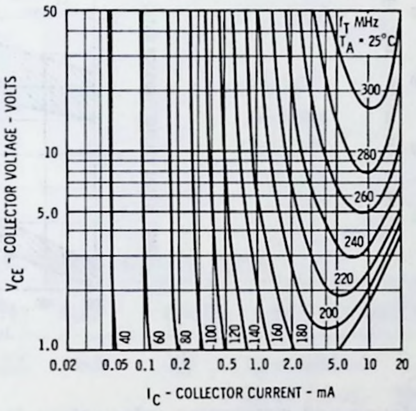
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



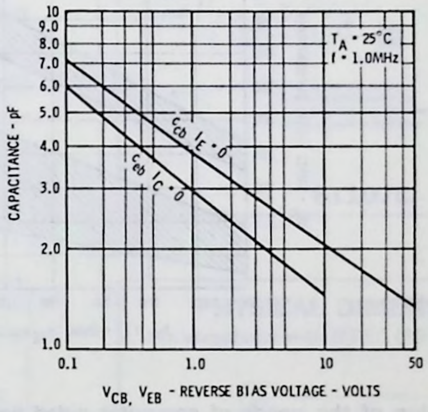
NOISE FIGURE VERSUS FREQUENCY



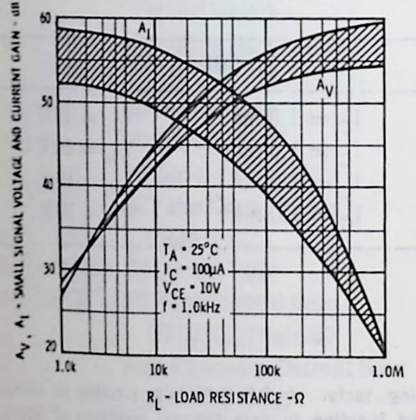
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



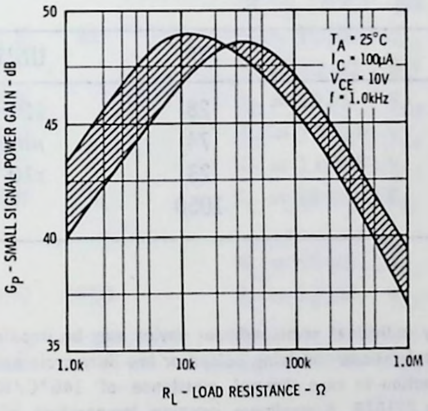
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



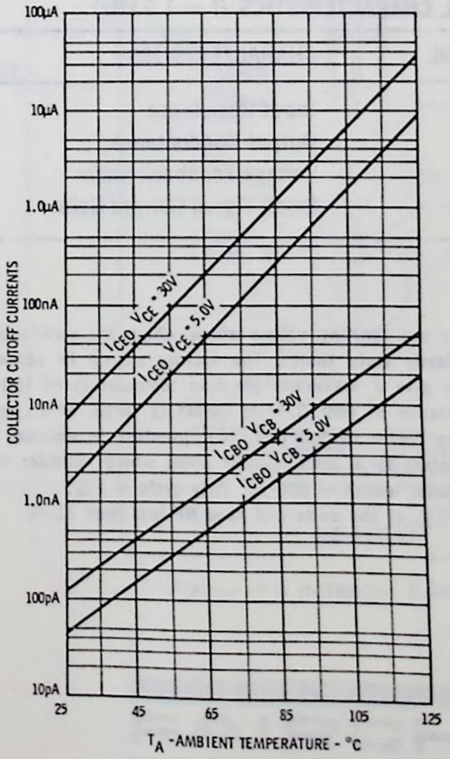
SMALL SIGNAL VOLTAGE AND CURRENT GAIN VERSUS LOAD RESISTANCE**



SMALL SIGNAL POWER GAIN VERSUS LOAD RESISTANCE**



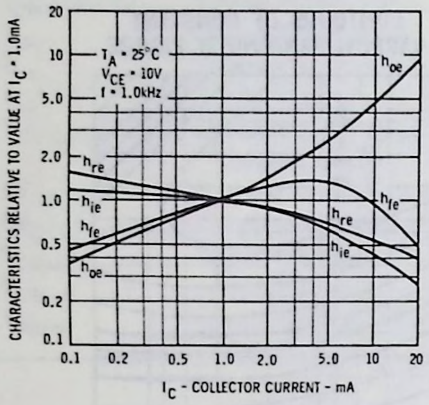
COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



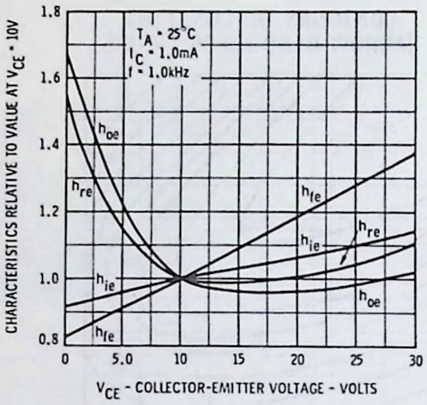
**In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

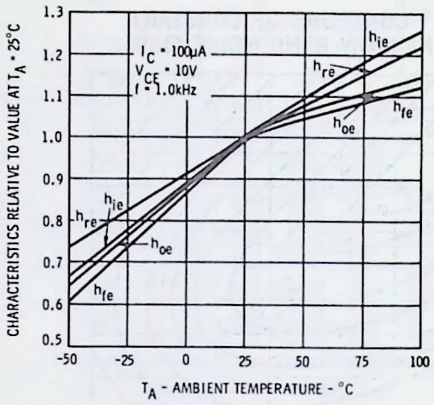
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



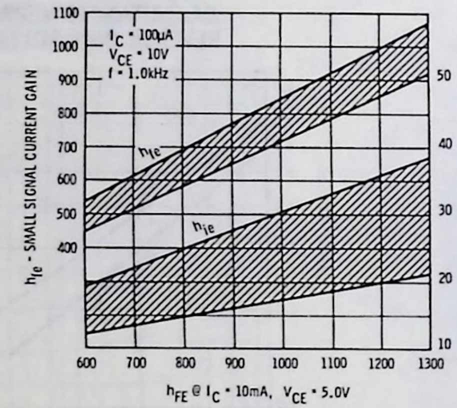
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



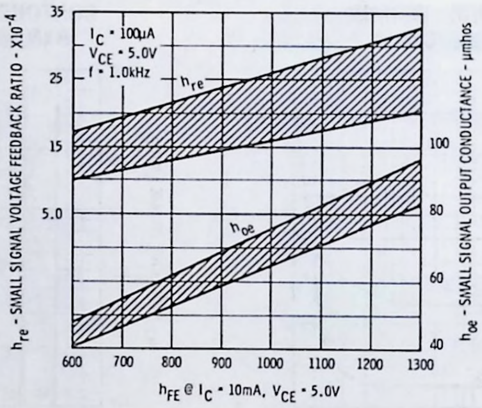
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



h PARAMETER CORRELATIONS**



h PARAMETER CORRELATIONS**



** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	28	kΩ	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{oe}	Output Conductance	74	μmhos	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{re}	Voltage Feedback Ratio	23	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain	1050		$I_C = 1.0$ mA	$V_{CE} = 10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction to ambien thermal resistance of 480°C/Watt (derating factor of 2.1 mW/°C) for FT107B. A maximum junction temperature of 125°C and junction to case thermal resistance of 200°C Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C) for SE4021.

(4) This rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) Normally >90% of the units will have NF less than 11 dB.

FT107C • SE4020

NPN LOW LEVEL, LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **LOW 1/f NOISE . . . . NF = 2.5 dB (TYP) AT 100 Hz; 1.0 kΩ**
- **HIGH GAIN . . . . h_{FE} = 100 (MIN) AT 10 μA**
  h_{FE} = 150 (MIN) AT 10 mA
- **LOW SATURATION VOLTAGE . . . $V_{CE(sat)}$ = 0.2 V (MAX) AT 10 mA/0.5 mA**
- **LOW LEAKAGE . . . . I_{CBO} = 2.0 nA (MAX) AT V_{CB} = 45 V**
  I_{CBO} = 50 nA (MAX) AT V_{CB} = 45 V, T_A = 65°C (SE4020)
  I_{CBO} = 1.0 μA (MAX) AT V_{CB} = 45 V, T_A = 125°C (FT107C)

ABSOLUTE MAXIMUM RATINGS (Note 1)

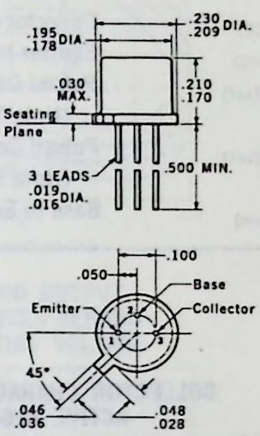
		FT107C	SE4020
Maximum Temperatures			
Storage Temperatures		−65°C to +150°C	−65°C to +125°C
Operating Junction Temperatures		+150°C	+125°C
Lead Temperature (Soldering, 10 seconds time limit)		+300°C	+260°C
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		0.86 Watt	0.5 Watt
25°C Ambient Temperature		0.26 Watt	0.2 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	60 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	8.0 Volts	8.0 Volts
I_C	Continuous Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		2.5	6.0	dB	I_C = 100 μA R_S = 1.0 kΩ	V_{CE} = 5.0 V BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		1.5	3.0	dB	I_C = 10 μA R_S = 10 kΩ	V_{CE} = 5.0 V BW = 400 Hz
NF	**Narrow-Band Noise Figure (f = 100 Hz)**		**2.5**		**dB**	**I_C = 100 μA** **R_S = 1.0 kΩ**	**V_{CE} = 5.0 V** **BW = 8.0 Hz**
NF	Wide-Band Noise Figure (f = 10 Hz to 10 kHz)		1.5	3.0	dB	I_C = 10 μA R_S = 10 kΩ	V_{CE} = 5.0 V BW = 15.7 kHz
h_{FE}	**DC Current Gain**	**100**	**205**			**I_C = 10 μA**	**V_{CE} = 5.0 V**
h_{FE}	DC Current Gain	120	245			I_C = 100 μA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	135	290			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**150**	**310**	**950**		**I_C = 10 mA**	**V_{CE} = 5.0 V**
h_{FE}(−55°C)	DC Current Gain	25				I_C = 10 μA	V_{CE} = 5.0 V
h_{FE}(100°C)	DC Pulse Current Gain (FT107C) (Note 5)		400	1450		I_C = 10 mA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.0	2.0			I_C = 10 mA	V_{CE} = 5.0 V

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline

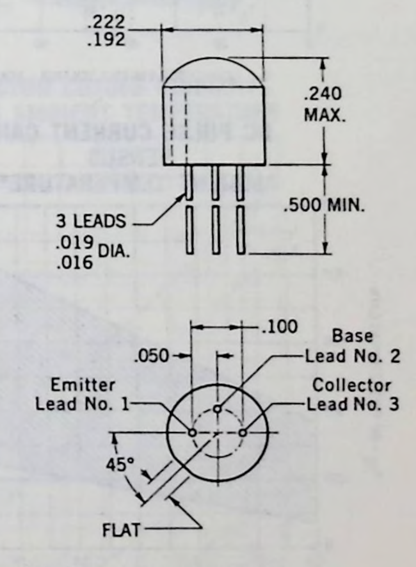


NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

FT107C

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

SE4020

*Planar is a patented Fairchild process.

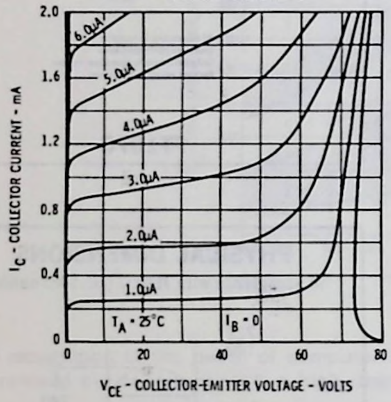
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

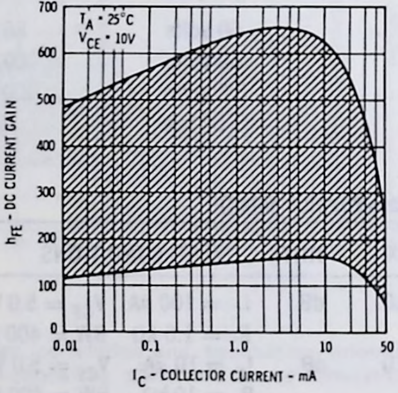
FAIRCHILD TRANSISTORS • FT107C • SE4020

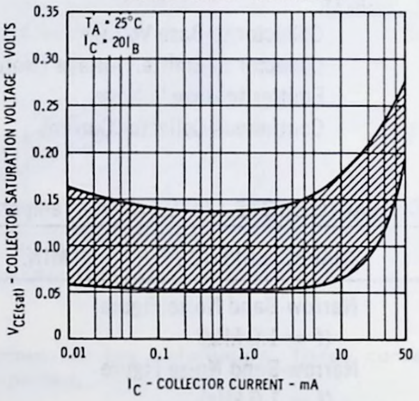
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

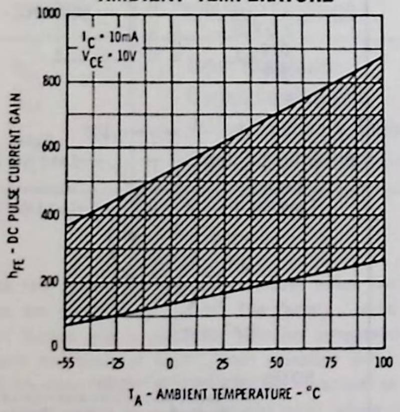
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	**Collector Cutoff Current**		**0.2**	**2.0**	**nA**	**$I_E = 0$**	**$V_{CB} = 45$ V**
I_{CBO}(65°C)	**Collector Cutoff Current** (SE4020)		**3.0**	**50**	**nA**	**$I_E = 0$**	**$V_{CB} = 45$ V**
I_{CBO}(125°C)	**Collector Cutoff Current** (FT107C)		**0.1**	**1.0**	**μA**	**$I_E = 0$**	**$V_{CB} = 45$ V**
I_{EBO}	Emitter Cutoff Current		0.007	1.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{cb}	Collector to Base Capacitance		2.5	4.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter to Base Capacitance		4.0	6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60			Volts	$I_C = 5.0$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	60			Volts	$I_C = 10\ \mu$A	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0			Volts	$I_C = 0$	$I_E = 10\ \mu$A
$V_{CE(sat)}$	**Pulsed Collector to Emitter Saturation Voltage** (Note 5)		**0.12**	**0.2**	**Volt**	**$I_C = 10$ mA**	**$I_B = 0.5$ mA**
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		0.17	0.3	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(on)}$	Base to Emitter On Voltage		0.64	0.7	Volt	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

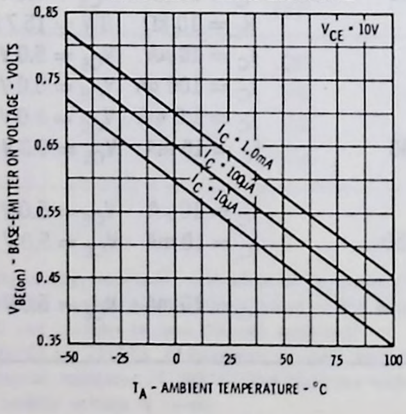
TYPICAL ELECTRICAL CHARACTERISTICS

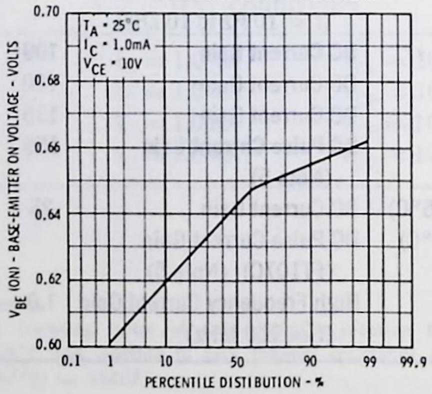

COLLECTOR CHARACTERISTICS* ACTIVE REGION


DC CURRENT GAIN VERSUS COLLECTOR CURRENT**


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT**


DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE**


BASE-EMITTER ON VOLTAGE VERSUS AMBIENT TEMPERATURE


DISTRIBUTION OF BASE-EMITTER ON VOLTAGE**

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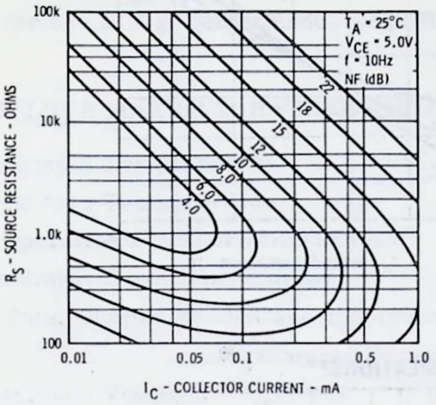
* Single family characteristic on Transistor Curve Tracer.

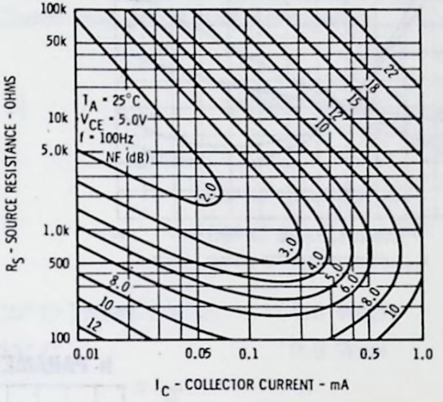
** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

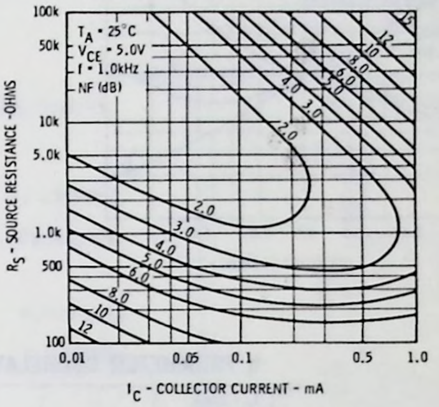
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



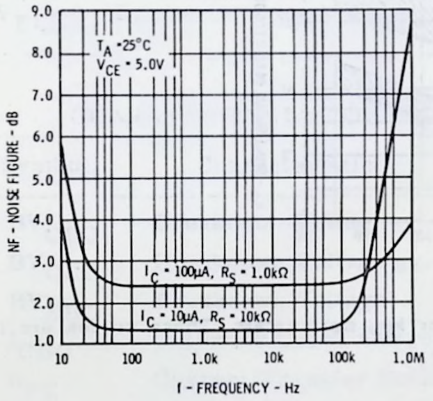
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



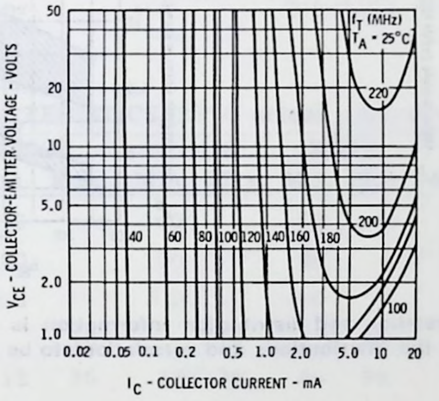
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



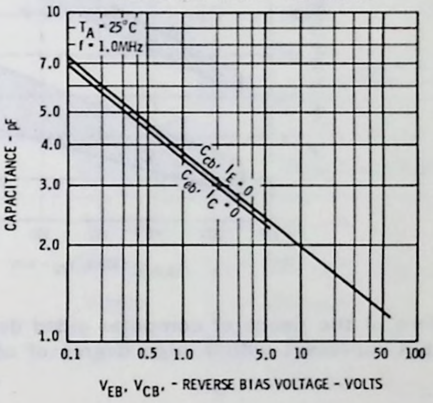
NOISE FIGURE VERSUS FREQUENCY



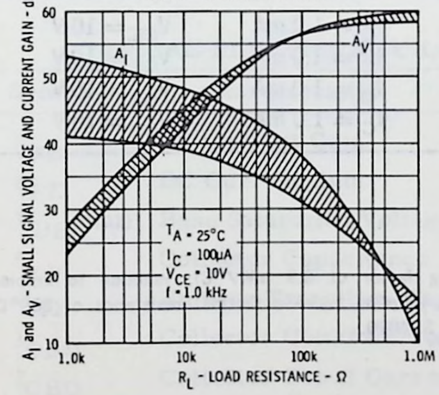
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



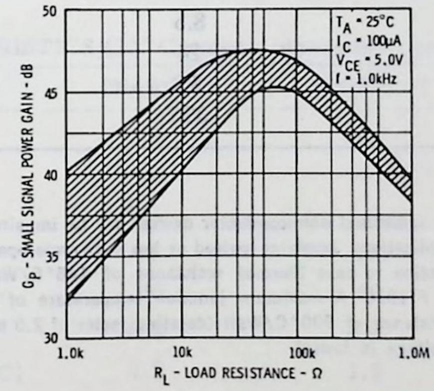
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



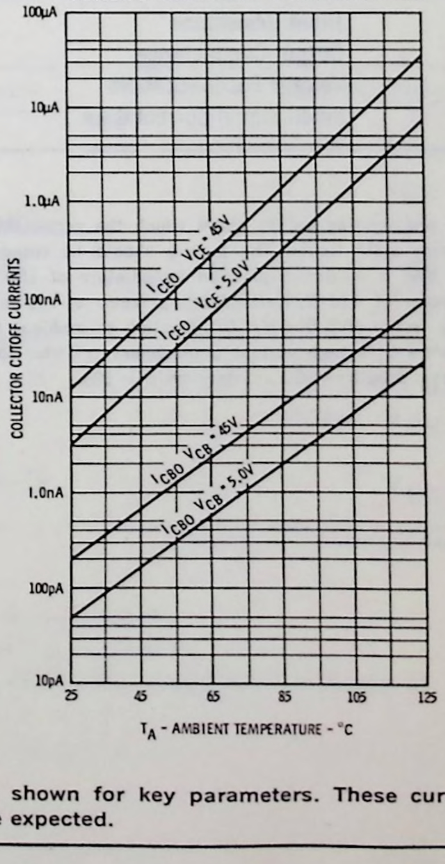
SMALL SIGNAL VOLTAGE AND CURRENT GAIN VERSUS LOAD RESISTANCE**



SMALL SIGNAL POWER GAIN VERSUS LOAD RESISTANCE**



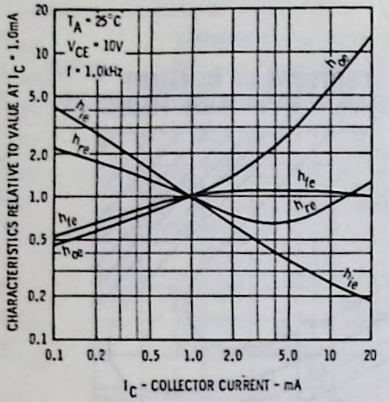
COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



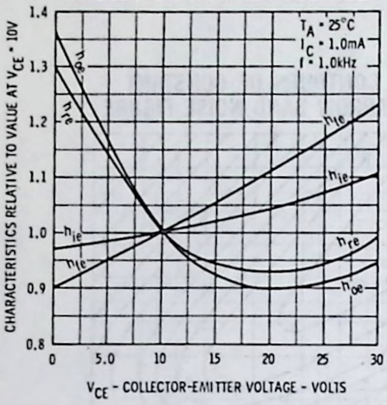
** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

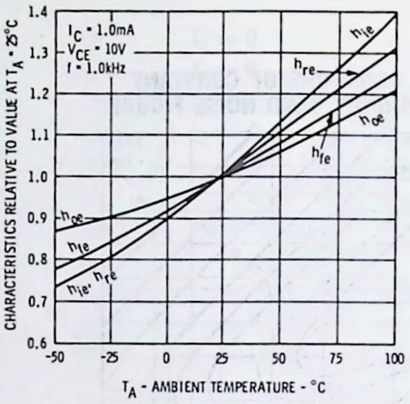
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



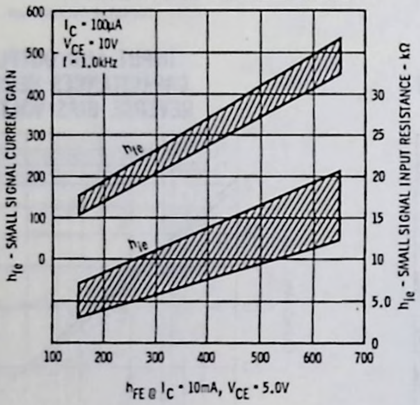
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



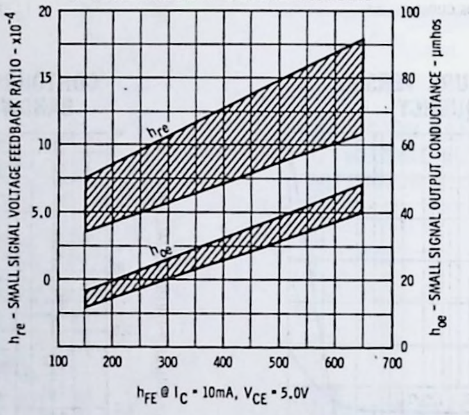
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



h PARAMETER CORRELATIONS**



h PARAMETER CORRELATIONS**



** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are no guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	8.5	kohms	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{oe}	Output Conductance	24	μmhos	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{re}	Voltage Feedback Ratio	7.0	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain	335		$I_C = 1.0$ mA	$V_{CE} = 10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction to ambient thermal resistance of 480°C/Watt (derating factor of 2.1 mW/°C) for FT107C. A maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C) for SE4020.
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N497 · 2N498 · 2N656 · 2N657

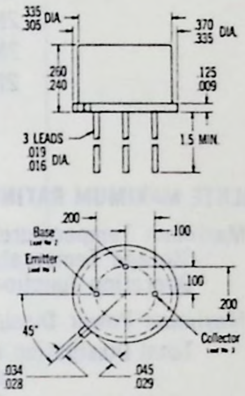
NPN GENERAL PURPOSE HIGH VOLTAGE

DIFFUSED SILICON PLANAR* TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3108 OR 2N3114

GENERAL DESCRIPTION - These high voltage NPN double diffused silicon transistors are designed for use in high performance amplifier, oscillator and switching circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (25° C) [Note 1]

	2N497/2N656	2N498/2N657
Maximum Temperatures		
Storage Temperature	-65° C to +300° C	-65° C to +300° C
Operating Junction Temperature	+200° C Maximum	+200° C Maximum
Maximum Power Dissipation		
Total Dissipation at Case Temperature 25° C [Note 2 & 3]	4.0 Watts	4.0 Watts
at Ambient Temperature 25° C	0.8 Watt	0.8 Watt
Maximum Voltages		
V_{CBO} Collector to Base Voltage	60 Volts	100 Volts
V_{CEO} Collector to Emitter Voltage	60 Volts	100 Volts
V_{EBO} Emitter to Base Voltage	8.0 Volts	8.0 Volts

GUARANTEED ELECTRICAL CHARACTERISTICS (25° C unless otherwise noted)

Symbol	Characteristic	2N497 Min.	2N497 Max.	2N498 Min.	2N498 Max.	2N656 Min.	2N656 Max.	2N657 Min.	2N657 Max.	Units	Test Conditions
BV_{CBO}	Breakdown Voltage	60		100		60		100		Volts	$I_C = 100\ \mu A$ $I_E = 0$
BV_{CEO}	Breakdown Voltage	60		100		60		100		Volts	$I_C = 250\ \mu A$ $I_B = 0$
BV_{EBO}	Breakdown Voltage	8.0		8.0		8.0		8.0		Volts	$I_E = 250\ \mu A$ $I_C = 0$
I_{CBO}	Collector Cutoff Current		10		10		10		10	μA	$I_E = 0$ $V_{CB} = 30$ V
h_{FE}	Current Transfer Ratio	12	36	12	36	30	90	30	90		$I_C = 200$ mA $V_{CE} = 10$ V
h_{IE}	Input Impedance		500		500		500		500	ohms	$I_B = 8.0$ mA $V_{CE} = 10$ V
R_{CS}	Saturation Resistance		25		25		25		25	ohms	$I_C = 200$ mA $I_B = 40$ mA

TYPICAL ELECTRICAL CHARACTERISTICS (25° C unless otherwise noted)

Symbol	Characteristic	2N497-98	2N656-57	Units	Test Conditions
h_{FE}	DC Current Gain	27	60		$I_C = 200$ mA $V_{CE} = 10$ V
h_{FE}	DC Current Gain	20	45		$I_C = 100\ \mu A$ $V_{CE} = 10$ V
V_{BE} (sat)	Base Saturation Voltage	1.1	1.1	Volts	$I_C = 200$ mA $I_B = 40$ mA
C_{ob}	Collector Capacitance	13	13	pF	$I_E = 0$ $V_{CB} = 10$ V
C_{TE}	Emitter Transition Capacitance	60	60	pF	$I_C = 0$ $V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current	0.4	0.4	$m\mu A$	$I_E = 0$ $V_{CB} = 90$ V
I_{CBO}	Collector Cutoff Current (150° C)	1.5	1.5	μA	$I_E = 0$ $V_{CB} = 90$ V
h_{fe}	High Frequency Current Gain f = 20 MHz	2.5	3.5		$I_C = 50$ mA $V_{CE} = 10$ V
I_{EBO}	Emitter Current	0.1	0.1	$m\mu A$	$I_C = 0$ $V_{EB} = 5.0$ V

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 43.8° C/Watt (derating factor of 22.8 mW/° C).

2N696 • 2N697 • 2N717 • 2N718 • 2N1420

NPN GENERAL PURPOSE TYPE

DIFFUSED SILICON TRANSISTORS

These transistors are designed for high-performance amplifier, oscillator and some switching applications. They perform at frequencies from dc to VHF and over more than 3 decades of current. Superior replacements offering PLANAR reliability and performance are available as the 2N1613, 2N1711 and 2N718A.

Type	Military Designation
2N696	MIL-S-19500/99A (Sig C)
2N697	MIL-S-19500/99A (Sig C)
2N1613	MIL-S-19500/181 (Navy)
2N1711	MIL-S-19500/225 (Navy)

ABSOLUTE MAXIMUM RATINGS [Note 1]	2N696 2N697 2N1420	2N717 2N718
Maximum Temperatures		
Storage Temperature	−65°C to +300°C	−65°C to +300°C
Operating Junction Temperature	175°C Maximum	175°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature [Note 2 & 3]	2.0 Watts	1.5 Watts
at 100°C Case Temperature [Note 2 & 3]	1.0 Watt	0.75 Watt
at 25°C Ambient Temperature	0.6 Watt	0.4 Watt
Maximum Voltages		
V_{CBO} Collector to Base Voltage	60 Volts	60 Volts
V_{CER} Collector to Emitter Voltage ($R_{BE} \leq 10\Omega$) [Note 4]	40 Volts (30V for 2N1420)	40 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	2N717 2N696 Min.	Typ.	Max.	2N718 2N697 Min.	Typ.	Max.	2N1420 Min.	Typ.	Max.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 5]	20	40	60	40	75	120	100		300		I_C = 150 mA V_{CE} = 10 V
V_{BE} (sat)	Base Saturation Voltage		1.0	1.3		1.0	1.3		1.0	1.3	Volts	I_C = 150 mA I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage		0.7	1.5		0.7	1.5		0.7	1.5	Volts	I_C = 150 mA I_B = 15 mA
h_{fe}	High Frequency Current Gain f = 20 mc	2.0	3.0		2.5	4.0		2.5	5.0			I_C = 50 mA V_{CE} = 10 V
C_{ob}	Output Capacitance		17	35		17	35		17	35	pf	I_E = 0 V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current		0.01	1.0		0.01	1.0		0.01	1.0	μA	I_E = 0 V_{CB} = 30 V
I_{CBO} (150°C)	Collector Cutoff Current		0.7	100		0.7	100		0.7	100	μA	I_E = 0 V_{CB} = 30 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

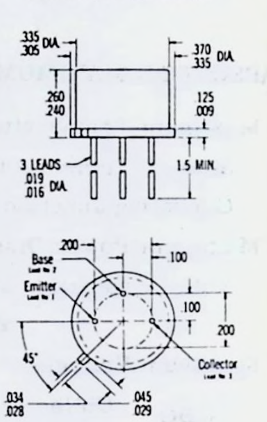
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 75°C/watt (derating factor of 13.3 mW/°C) for the 2N696, 2N697 and 2N1420; junction-to-case thermal resistance of 100°C/watt (derating factor of 10mW/°C) for the 2N717 and 2N718.

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

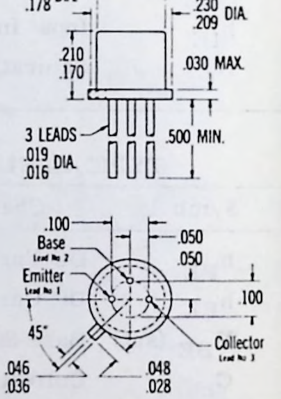
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N696 • 2N697 • 2N1420

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N717 • 2N718

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

SMALL SIGNAL CHARACTERISTICS (f = 1KC)

SYMBOL	CHARACTERISTICS	Min.	Typ.	Max.	UNITS	TEST CONDITIONS
h_{ib}	Input Resistance	24	27	34	Ohms	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
		4.0	6.3	8.0	Ohms	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio		0.7	3.0	$\times 10^{-4}$	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
			0.8	3.0	$\times 10^{-4}$	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain	30	55	100		$I_C = 1.0$ mA $V_{CE} = 5.0$ V
		35	70	150		$I_C = 5.0$ mA $V_{CE} = 10$ V
h_{ob}	Output Conductance	0.1	0.16	0.5	μmho	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
		0.1	0.19	1.0	μmho	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{ie}	Input Resistance		2.2		K ohms	$I_C = 1.0$ mA $V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio		3.6		$\times 10^{-4}$	$I_C = 1.0$ mA $V_{CE} = 5.0$ V
h_{oe}	Output Conductance		12.5		μmho	$I_C = 1.0$ mA $V_{CE} = 5.0$ V

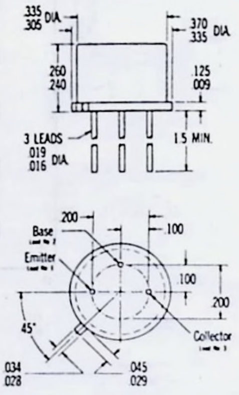
2N698

NPN GENERAL PURPOSE HIGH VOLTAGE TYPE

DIFFUSED SILICON PLANAR* TRANSISTOR

GENERAL DESCRIPTION - NPN double diffused silicon Planar* transistor designed for a wide variety of amplifier, oscillator and switching circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 1.10 grams

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures		
Storage Temperature		-65° C to +300° C
Operating Junction Temperature		+200° C Maximum
Maximum Power Dissipation		
Total Dissipation at Case Temperature	25° C [Note 2 & 3]	3.0 Watts
at Case Temperature	100° C [Note 2 & 3]	1.7 Watts
at Free-Air Temperature	25° C	0.8 Watt
Maximum Voltages		
V_{CBO} Collector to Base Voltage		120 Volts
V_{CER} Collector to Emitter Voltage ($R_{BE} \leq 10\ \Omega$) [Note 4]		80 Volts
V_{CEO} Collector to Emitter Voltage	[Note 4]	60 Volts
V_{EBO} Emitter to Base Voltage		7.0 Volts

ELECTRICAL CHARACTERISTICS (25° C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain [Note 5]	20	60		I_C = 150 mA V_{CE} = 10 V
V_{BE} (sat)	Base Saturation Voltage		0.9	Volts	I_C = 50 mA I_B = 5.0 mA
V_{CE} (sat)	Collector Saturation Voltage		1.2	Volts	I_C = 50 mA I_B = 5.0 mA
V_{BE} (sat)	Base Saturation Voltage		1.3	Volts	I_C = 150 mA I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage		5.0	Volts	I_C = 150 mA I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0			I_C = 50 mA V_{CE} = 10 V
C_{obo}	Output Capacitance		15	pF	I_E = 0 V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		85	pF	I_C = 0 V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		5.0	mμA	I_E = 0 V_{CB} = 75 V
I_{CBO} (150° C)	Collector Cutoff Current		15	μA	I_E = 0 V_{CB} = 75 V
BV_{CBO}	Collector to Base Breakdown Voltage	120		Volts	I_C = 100 μA I_E = 0
V_{CER} (sust)	Collector to Emitter Sustaining Voltage [Note 4]	80		Volts	I_C = 100 mA (pulsed) $R_{BE} \leq 10\ \Omega$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 4]	60		Volts	I_C = 30 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		Volts	I_C = 0 I_E = 100 μA
I_{EBO}	Emitter Cutoff Current		10	mμA	I_C = 0 V_{EB} = 5.0 V

SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{ib}	Input Resistance	20	35	ohms	I_C = 1.0 mA V_{CB} = 5.0 V
			10	ohms	I_C = 5.0 mA V_{CB} = 10 V
h_{rb}	Voltage Feedback Ratio		2.5	$\times 10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
			5.0	$\times 10^{-4}$	I_C = 5.0 mA V_{CB} = 10 V
h_{fe}	Small Signal Current Gain	15			I_C = 1.0 mA V_{CE} = 5.0 V
		25			I_C = 5.0 mA V_{CE} = 10 V
h_{ob}	Output Conductance		0.5	μmho	I_C = 1.0 mA V_{CB} = 5.0 V
			1.0	μmho	I_C = 5.0 mA V_{CB} = 10 V

* Planar is a patented Fairchild proce

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58.3° C/watt (derating factor of 17.2 mW/°C).

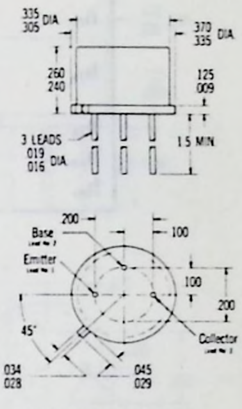
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

(5) Pulse conditions: length = 300 μsec; duty cycle $\leq$ 1%.

2N699 • 2N719 • 2N720
NPN HIGH VOLTAGE TYPES
DIFFUSED SILICON TRANSISTORS

These NPN double-diffused silicon transistors are designed for use in high performance amplifier, oscillator and switching circuits. They provide greater voltage swings in oscillator and amplifier circuits due to their 120 volt collector-to-base voltage rating.

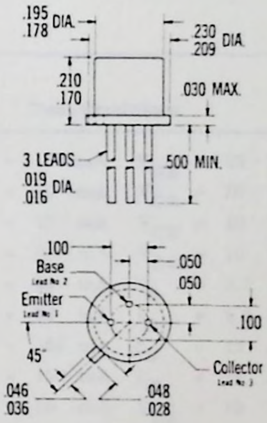
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N699

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N719 2N720

ABSOLUTE MAXIMUM RATINGS [Note 1]

	2N699	2N719 2N720
Maximum Temperatures		
Storage Temperature	−65°C to +300°C	−65°C to +300°C
Operating Junction Temperature	175°C Maximum	175°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature [Note 2 & 3]	2.0 Watts	1.5 Watts
at 100°C Case Temperature [Note 2 & 3]	1.0 Watt	0.75 Watt
at 25°C Ambient Temperature	0.6 Watt	0.4 Watt
Maximum Voltages		
V_{CBO} Collector to Base Voltage	120 Volts	120 Volts
V_{CER} Collector to Emitter Voltage ($R \leq 10\Omega$) [Note 4]	80 Volts	80 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C)

		2N699 2N720			2N719				
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 5]	40	80	120	20	40	60		$I_C = 150mA$ $V_{CE} = 10V$
$V_{BE}(sat)$	Base Saturation Voltage		0.92	1.3		0.92	1.3	Volts	$I_C = 150mA$ $I_B = 15mA$
$V_{CE}(sat)$	Collector Saturation Voltage		2.5	5.0		2.5	5.0	Volts	$I_C = 150mA$ $I_B = 15mA$
C_{ob}	Output Capacitance		12	20		12	20	pf	$I_E = 0$ $V_{CB} = 10V$
h_{fe}	High Frequency Current Gain f = 20 mc	2.5	4.0		2.0				$I_C = 50mA$ $V_{CE} = 10V$
I_{CBO}	Collector Cutoff Current			2.0			2.0	µA	$I_E = 0$ $V_{CB} = 60V$
I_{CBO} (150°C)	Collector Cutoff Current		1.5	200		1.5	200	µA	$I_E = 0$ $V_{CB} = 60V$
I_{EBO}	Emitter Cutoff Current			100†				µA	$I_C = 0$ $V_{EB} = 2.0V$

† 2N699 only.

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NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 100°C/watt (derating factor of 10mW/°C) for the 2N719 and 2N720; junction-to-case thermal resistance of 75°C/watt (derating factor of 13.3 mW/°C) for the 2N699.
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

SMALL SIGNAL CHARACTERISTICS (f=1kc)

		2N699 2N720			2N719				
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX	MIN.	TYP.	MAX	UNITS	TEST CONDITIONS
h_{ib}	Input Resistance	20	27	30	20	27	35	Ohms	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
			6.3	10		6.3		Ohms	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{ob}	Output Conductance	0.1	0.12	0.5	0.1	0.12	0.5	μmho	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
			0.13	1.0		0.13	1.0	μmho	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio		0.4	2.5		0.25	5.0	$\times 10^{-4}$	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
			0.5	3.0		0.4		$\times 10^{-4}$	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain	35	60	100	15	35			$I_C = 1.0$ mA $V_{CE} = 5.0$ V
		45	75		25	45			$I_C = 5.0$ mA $V_{CE} = 10$ V
h_{ie}	Input Resistance		750			600		Ohms	$I_C = 5.0$ mA $V_{CE} = 10$ V
h_{oe}	Output Conductance		16			25		μmho	$I_C = 5.0$ mA $V_{CE} = 10$ V
h_{re}	Voltage Feedback Ratio		1.05			0.9		$\times 10^{-4}$	$I_C = 5.0$ mA $V_{CE} = 10$ V

2N699B · 2N1893

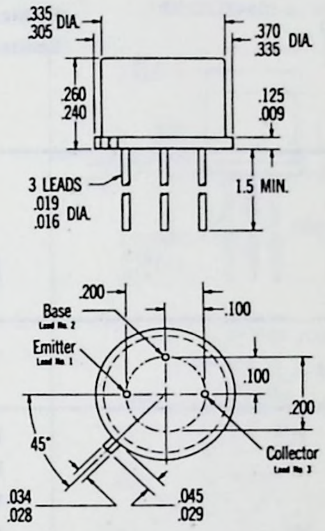
NPN GENERAL PURPOSE HIGH VOLTAGE TYPE

DIFFUSED SILICON PLANAR TRANSISTORS

ENERAL DESCRIPTION The 2N699B · 2N1893 are High-Voltage, NPN Double-Diffused Silicon Planar ransistors designed for use in high-performance amplifier, oscillator and switching circuits. The 699B is rated at 5.0 watts and the 2N1893 at 3.0 watts.

hese transistors provide greater voltage swings in oscillator and amplifier circuits and more protection inductive switching circuits due to their 120 volt collector-to-base voltage rating.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

BSOLUTE MAXIMUM RATINGS

		2N699 B	2N1893
Maximum Temperatures			
Storage Temperature		-65°C to +300°C	-65°C to +300°C
Operating Junction Temperature		200°C Maximum	200°C Maximum
Lead Temperature (Soldering, No Time Limit)		300°C Maximum	300°C Maximum
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		5.0 Watts	3.0 Watts
at 100°C Case Temperature		2.8 Watts	1.7 Watts
at 25°C Ambient Temperature		0.87 Watt	0.8 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	120 Volts	120 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\,\Omega$) (Note 4)	100 Volts	100 Volts
V_{CEO}	Collector to Emitter (Note 4)	80 Volts	80 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts	7.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N699B Min.	2N699B Typ.	2N699B Max.	2N1893 Min.	2N1893 Typ.	2N1893 Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	40	80	120	40	80	120		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	35	80		35	80			I_C = 10 mA V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	20	40		20	40			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	20	50		20	50			I_C = 0.1 mA V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage		0.82	1.0		0.82	0.9	Volts	I_C = 50 mA I_B = 5.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.5	1.2		0.5	1.2	Volts	I_C = 50 mA I_B = 5.0 mA
V_{BE}(sat)	Base Saturation Voltage		0.96	1.3		0.96	1.3	Volts	I_C = 150 mA I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage		2.0	5.0		2.0	5.0	Volts	I_C = 150 mA I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 Mc)	3.0	3.5		2.5	3.5			I_C = 50 mA V_{CE} = 10 V

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OTES:

These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/Watt (derating factor of 28.6 mW/°C) for the 2N699B; for the 2N1893 58.3°C/Watt (derating factor of 17.2 mW/°C). Junction-to-ambient thermal resistance of 201°C/Watt (derating factor of 4.97 mW/°C) for 2N699B; for the 2N1893 219°C/Watt (derating factor of 4.56 mW/°C).

Rating refers to a high current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μsec; duty cycle = 1%.

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N699B Min.	2N699B Typ.	2N699B Max.	2N1893 Min.	2N1893 Typ.	2N1893 Max.	Units	Test Conditions	
C_{obo}	Output Capacitance		13	15		13	15	pf	$I_E = 0$	$V_{CB} = 10$ V
C_{ibo}	Emitter Transition Capacitance		55	85		55	85	pf	$I_C = 0$	$V_{EB} = 0.5$ V
*I_{CBO}	Collector Cutoff Current		0.3	10		0.3	10	nA	$I_E = 0$	$V_{CB} = 90$ V
I_{CBO}(150°C)	Collector Cutoff Current		1.5	15		1.5	15	μA	$I_E = 0$	$V_{CB} = 90$ V
BV_{CBO}	Collector to Base Breakdown Voltage	120			120			Volts	$I_C = 100$ μA	$I_E = 0$
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	100			100			Volts	$I_C = 100$ mA (pulsed)	$R_{BE} \leq 10$ Ω
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	80			80			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			7.0			Volts	$I_C = 0$	$I_E = 100$ μA
I_{EBO}	Emitter Current		0.05	10		0.05	10	nA	$I_C = 0$	$V_{EB} = 5.0$ V

SMALL SIGNAL CHARACTERISTICS (f = 1 KC)

Symbol	Characteristic	2N699B Min.	2N699B Typ.	2N699B Max.	2N1893 Min.	2N1893 Typ.	2N1893 Max.	Units	Test Conditions	
h_{ib}	Input Resistance	20	27	30	20	27	30	Ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ib}	Input Resistance	4.0	6.4	8.0	4.0	6.4	8.0	Ohms	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio		0.5	1.25		0.5	1.25	$x10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{rb}	Voltage Feedback Ratio		0.6	1.50		1.6	1.50	$x10^{-4}$	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain	35	70	100	30	70	100		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain	45	85		45	85			$I_C = 5.0$ mA	$V_{CE} = 10$ V
h_{ob}	Output Conductance	0.1	0.12	0.5		0.12	0.5	μmho	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance		0.14	0.5		0.14	0.5	μmho	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{ie}	Input Resistance		2.8			2.8		Kohms	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio		3.5			3.5		$x10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance		11			11		μmho	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

2N703

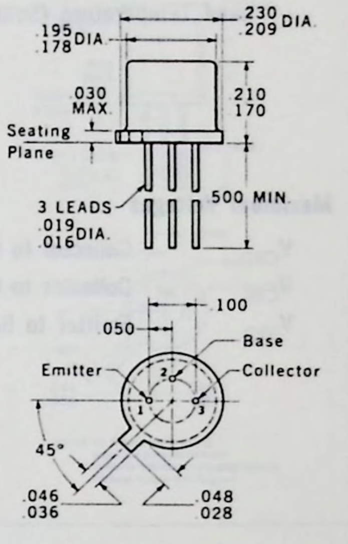
NPN HIGH-SPEED, HIGH-CURRENT SWITCH

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N916

GENERAL DESCRIPTION - The Fairchild 2N703 is an NPN silicon PLANAR transistor designed primarily for low power, non-saturating switching applications and high frequency amplifier and oscillator circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature		-65°C to +175°C
Operating Junction Temperature		175°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.6 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.3 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		25 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	25 Volts
V_{EBO}	Emitter to Base Voltage		5.0 Volts
I_C	Collector Current		50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain [Note 5]	40	100		I_C = 10 mA	V_{CE} = 5.0 V
h_{FE}(-55°C)	DC Current Gain [Note 5]	20			I_C = 10 mA	V_{CE} = 5.0 V
V_{CE}(sat)	Collector Saturation Voltage [Note 5]		0.5	Volts	I_C = 10 mA	I_B = 0.5 mA
V_{BE}	Base to Emitter Voltage	0.7	0.95	Volts	I_C = 10 mA	V_{CE} = 5.0 V
I_{CBO}	Collector Cutoff Current		0.5	μA	V_{CB} = 10 V	I_E = 0
I_{CBO}(150°C)	Collector Cutoff Current		50	μA	V_{CB} = 10 V	I_E = 0
I_{CEO}	Collector Cutoff Current		10	μA	V_{CE} = 20 V	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	25		Volts	I_{CBO} = 5.0 μA	I_E = 0
BV_{CEO}	Collector to Emitter Breakdown Voltage	25		Volts	I_{CEO} = 2.0 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	I_{EBO} = 10 μA	I_C = 0
C_{ob}	Output Capacitance (f = 1.0 mc)		6.0	pf	V_{CB} = 5.0 V	I_E = 0
f_T	Gain Bandwidth Product	70		mc	V_{CE} = 5.0 V	I_E = -10 mA

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NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 250°C/Watt (derating factor of 4.0 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle ≈ 2%.

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2N706

NPN HIGH SPEED SATURATED SWITCH

SILICON PLANAR* TRANSISTOR

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum

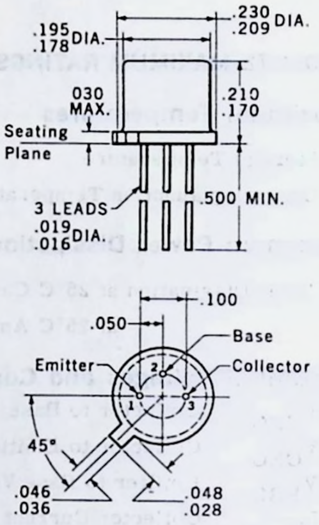
Maximum Voltages

V_{CBO}	Collector to Base Voltage	25 V
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leqq 10\,\Omega$) (Note 2)	20 V
V_{EBO}	Emitter to Base Voltage	3 V

Maximum Power Dissipation

Total Dissipation at Case Temperature 25°C (Note 3)	1.0 Watt
at Case Temperature 100°C	0.5 Watt
at Free Air Temperature 25°C	0.3 Watt

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.44 gram

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	20				$I_C = 10$ mA	$V_{CE} = 1.0$ V
$V_{BE(sat)}$	Base Saturation Voltage		0.75	0.9	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.3	0.6	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
h_{fe}	Small Signal Current Gain (f = 100 MHz)	2.0	4.0			$I_C = 10$ mA	$V_{CE} = 15$ V
C_{obo}	Collector Capacitance		5.0	6.0	pF	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}	Collector Cutoff Current		0.005	0.05	μA	$V_{CB} = 15$ V	$I_E = 0$
I_{CBO}(150°C)	Collector Cutoff Current		3.5	30	μA	$V_{CB} = 15$ V	$I_E = 0$
τ_s	Charge Storage Time Constant (See Fairchild 2N708 Data Sheet for exact circuit)		16	60	ns	$I_C = 10$ mA $I_{B1} = I_{B2} = 10$ mA	$V_{CC} = 10$ V $R_L = 1$ kΩ

*Planar is a patented Fairchild process.

NOTES:

(1) The maximum ratings are limiting absolute values above which life or satisfactory performance may be impaired.
(2) Rating refers to a high current point where collector to emitter voltage is lowest.
(3) These ratings give maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/watt (derating factor of 6.7 mW/°C).
(4) Pulse conditions: Length = 300 μs; duty cycle ≦ 1%.

2N708

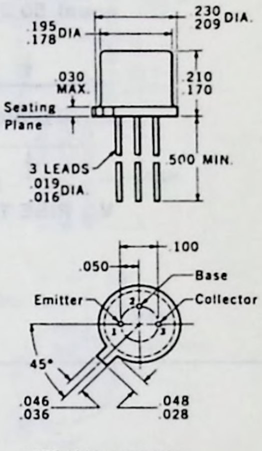
NPN HIGH-FREQUENCY AND LOW-STORAGE

DIFFUSED SILICON PLANAR* TRANSISTOR

The 2N708 is an NPN silicon transistor designed specifically as a high-speed saturated logic switch to replace the 2N706 (A, B), 2N753 mesa series.

The Fairchild PLANAR structure extends the range of useful current gain down to the microampere region. Other features are lower leakage current, increased maximum ratings, reduced storage time, higher beta, and lower saturation voltage relative to its predecessors.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures			
Storage Temperature			−65°C to +300°C
Operating Junction Temperature			200°C Maximum
Lead Temperature (Soldering, No Time Limit)			300°C Maximum
Maximum Power Dissipation			
Total Dissipation at Case Temperature	25°C	[Note 2 & 3]	1.2 Watts
at Case Temperature	100°C	[Note 2 & 3]	.68 Watt
at Ambient Temperature	25°C	[Note 2 & 3]	.36 Watt
Maximum Voltages			
V_{CBO} Collector to Base Voltage			40 Volts
V_{CER} Collector to Emitter Voltage ($R_{BE} \leq 10\,\Omega$)		[Note 4]	20 Volts
V_{CEO} Collector to Emitter Voltage		[Note 4]	15 Volts
V_{EBO} Emitter to Base Voltage			5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 5]	30	120		$I_C = 10$ mA $V_{CE} = 1.0$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	15			$I_C = 10$ mA $V_{CE} = 1.0$ V
h_{FE}	DC Current Gain	15			$I_C = 0.5$ mA $V_{CE} = 1.0$ V
V_{BE} (sat)	Base Saturation Voltage	.72	.80	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		.40	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{BE} (sat)	Base Saturation Voltage (−55°C)		.90	Volts	$I_C = 7.0$ mA $I_B = 0.7$ mA
V_{CE} (sat)	Collector Saturation Voltage (−55°C to +125°C)		.40	Volts	$I_C = 7.0$ mA $I_B = 0.7$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0			$I_C = 10$ mA $V_{CE} = 10$ V
C_{obo}	Output Capacitance		6.0	pF	$I_E = 0$ $V_{CB} = 10$ V
r_b'	Base Spreading Resistance [Note 6] (f = 300 MHz)		50	ohms	$I_C = 10$ mA $V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current		25	mμA	$I_E = 0$ $V_{CB} = 20$ V
I_{CBO} (150°C)	Collector Cutoff Current		15	μA	$I_E = 0$ $V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40		Volts	$I_C = 1.0\ \mu$A $I_E = 0$
V_{CER} (sust)	Collector to Emitter Sustaining Voltage [Note 4 & 5]	20		Volts	$I_C = 30$ mA $R_{BE} \leq 10\,\Omega$ (pulsed)
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 4 & 5]	15		Volts	$I_C = 30$ mA $I_B = 0$ (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	$I_C = 0$ $I_E = 10\ \mu$A
I_{EBO}	Emitter Cutoff Current		0.1	μA	$I_C = 0$ $V_{EB} = 4.0$ V
I_{CEX} (125°C)	Collector-Emitter Cutoff Current		10	μA	$V_{CE} = 20$V $V_{BE} = .25$ V
τ_s	Charge Storage Time Constant [Note 7] [See circuit]		25	nsec	$I_C = I_{B1} \approx 10$ mA $I_{B2} \approx -10$ mA
t_{on}	Turn On Time [See circuit]		40	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA, $V_{BE} = -2.0$ V
t_{off}	Turn Off Time [See circuit]		75	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA, $I_{B2} \approx -1.0$ mA

* Planar is a patented Fairchild process.

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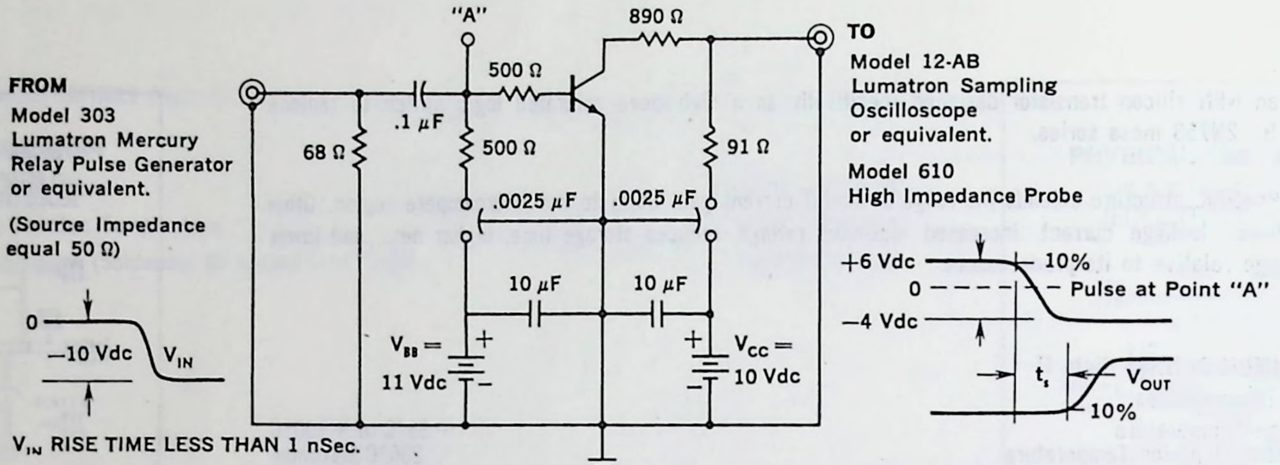
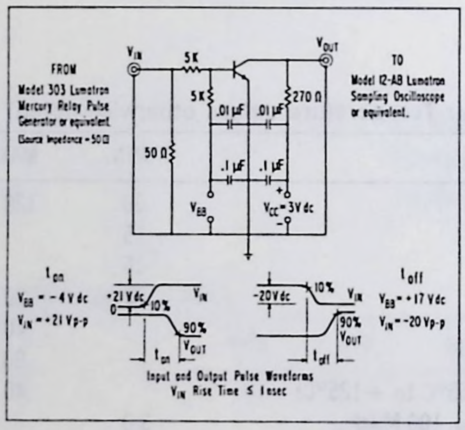
CHARGE STORAGE TIME CONSTANT TEST CIRCUIT AND WAVEFORMS


FROM
Model 303
Lumatron Mercury
Relay Pulse Generator
or equivalent.
(Source Impedance
equal 50 Ω)
0
−10 Vdc
V_{IN}
"A"
890 Ω
500 Ω
.1 μF
68 Ω
500 Ω
.0025 μF
.0025 μF
91 Ω
10 μF
10 μF
V_{BB} =
11 Vdc
V_{CC} =
10 Vdc
TO
Model 12-AB
Lumatron Sampling
Oscilloscope
or equivalent.
Model 610
High Impedance Probe
+6 Vdc
10%
0
Pulse at Point "A"
−4 Vdc
t_s
V_{OUT}
10%

V_{IN} RISE TIME LESS THAN 1 nSec.

T_{on} AND T_{off} TEST CIRCUIT


V_{IN}
5K
V_{OUT}
FROM
Model 303 Lumatron
Mercury Relay Pulse
Generator or equivalent.
(Source Impedance = 50 Ω)
5K
270 Ω
TO
Model 12-AB Lumatron
Sampling Oscilloscope
or equivalent.
.01 μF
.01 μF
50 Ω
.1 μF
.1 μF
V_{BB}
V_{CC} = 3V dc
t_{on}
V_{BB} = −4 V dc
V_{IN} = +21 Vp-p
+21 V dc
0
10%
V_{IN}
90%
V_{OUT}
t_{on}
−20 V dc
10%
V_{IN}
90%
V_{OUT}
t_{off}
t_{off}
V_{BB} = +17 V dc
V_{IN} = −20 Vp-p

Input and Output Pulse Waveforms
V_{IN} Rise Time ≤ 1 nsec

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6. mW/°C); junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) $r_b' = h_{ie}$ (Real Part) — Measured with GR #1607-A Bridge.
(7) Measured on Sampling Scope. PW ≤ 400 nsec.

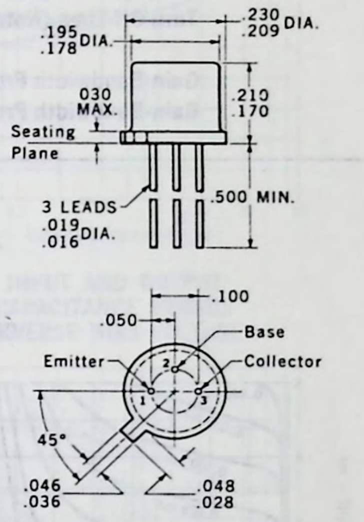
2N709 • FT709

HIGH SPEED SATURATED SWITCHES

FAIRCHILD NPN DIFFUSED SILICON PLANAR* TRANSISTORS

- **ULTRA HIGH SPEED . . . .** $\tau_S = 6.0$ **ns (MAX), 3.0 ns (TYP) AT 5.0 mA**
  $t_{on} = 12$ **ns (MAX) AT 10 mA**
  $t_{off} = 12$ **ns (MAX) AT 10 mA**
- **HIGH FREQUENCY . . . .** $f_T = 600$ **MHz (MIN), 800 MHz (TYP) AT 10 mA**
- **LOW CAPACITANCE . . . .** $C_{obo} = 3.0$ **pF (MAX) AT 5.0 V**
  $C_{ibo} = 2.0$ **pF (MAX) AT 0.5 V**
- **BREAKDOWN VOLTAGE . . .** $LV_{CEO} = 6.0$ **V (MIN)**
- **SATURATED BETA GUARANTEES FROM 1.0 mA TO 30 mA**
- **SIX V_{CE}(sat) GUARANTEES WITH THREE AT +125°C**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.44 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, no time limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 100°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.3 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	15 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	6.0 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N709 MIN.	 TYP.	 MAX.	FT709 MIN.	 TYP.	 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**				**30**	**70**	**125**		$I_C = 10$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Current Gain	20	55	120					$I_C = 10$ mA	$V_{CE} = 0.5$ V
h_{FE}	**DC Current Gain**				**20**				$I_C = 1.0$ mA	$V_{CE} = 0.4$ V
h_{FE}	**DC Current Gain**				**20**				$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Current Gain	15							$I_C = 30$ mA	$V_{CE} = 1.0$ V
h_{FE}(−55°C)	**DC Current Gain**				**12**				$I_C = 10$ mA	$V_{CE} = 0.4$ V
h_{FE}(−55°C)	DC Current Gain	10							$I_C = 10$ mA	$V_{CE} = 0.5$ V
V_{BE}(sat)	Base Saturation Voltage	0.70	0.78	0.85				Volts	$I_C = 3.0$ mA	$I_B = 0.15$ mA
V_{BE}(sat)	Base Saturation Voltage				0.68	0.73	0.85	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{BE}(sat)	Base Saturation Voltage				0.75	0.83	0.95	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage					0.92	1.3	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE}(sat)	Collector Saturation Voltage					0.18	0.25	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{CE}(sat)	**Collector Saturation Voltage**					**0.18**	**0.25**	**Volts**	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	**Collector Saturation Voltage**		**0.21**	**0.30**				**Volts**	$I_C = 3.0$ mA	$I_B = 0.15$ mA
V_{CE}(sat)	**Collector Saturation Voltage (125°C)**					**0.20**	**0.32**	**Volts**	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{CE}(sat)	**Collector Saturation Voltage**					**0.22**	**0.38**	**Volts**	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE}(sat)	**Collector Saturation Voltage (125°C)**					**0.20**	**0.42**	**Volts**	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	**Collector Saturation Voltage (125°C)**					**0.23**	**0.45**	**Volts**	$I_C = 30$ mA	$I_B = 3.0$ mA
C_{obo}	**Output Capacitance**		**2.5**	**3.0**		**2.3**	**3.0**	**pF**	$I_E = 0$	$V_{CB} = 5.0$ V
C_{ibo}	**Input Capacitance**		**1.4**	**2.0**		**1.8**	**2.0**	**pF**	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		5.0	50		4.0	50	nA	$I_E = 0$	$V_{CB} = 5.0$ V
I_{CBO}(125°C)	Collector Cutoff Current		1.0	5.0		1.0	5.0	μA	$I_E = 0$	$V_{CB} = 5.0$ V

Additional Electrical Characteristics on page 4
Notes on page 4

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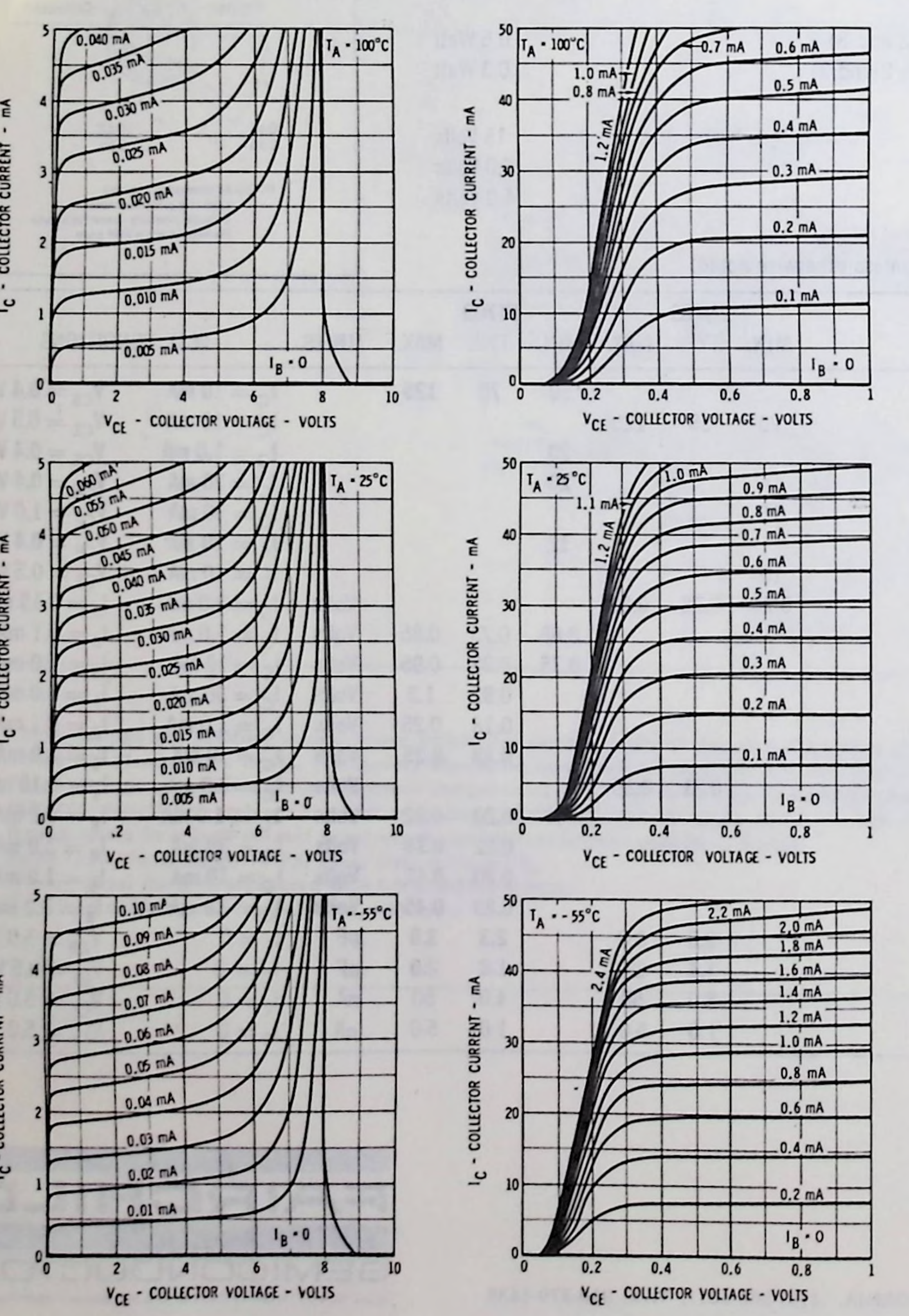
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

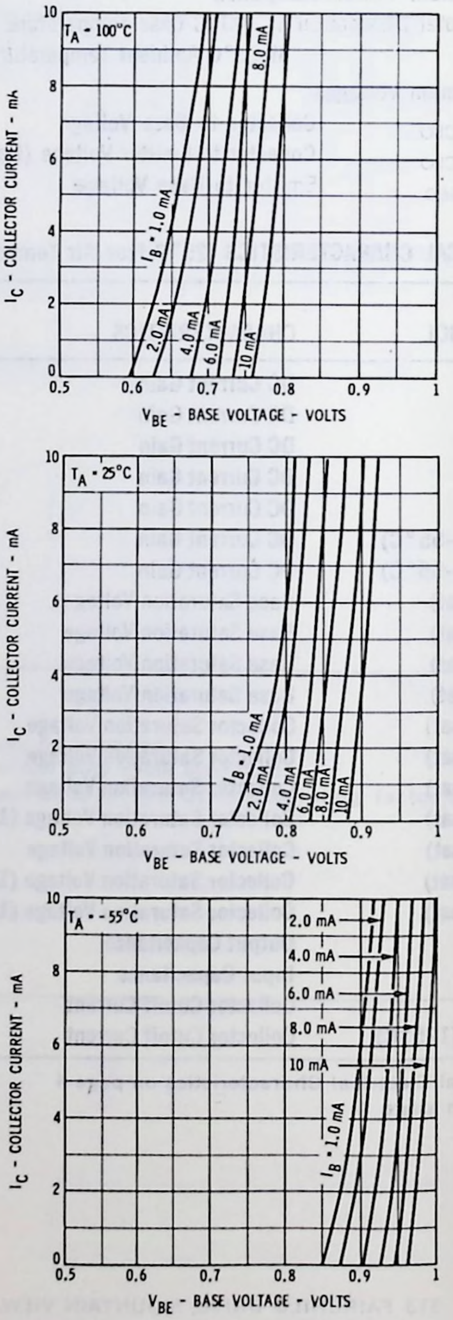
		2N709			FT709					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CBO}	Collector to Base Breakdown Voltage	15			15			Volts	$I_C = 10\ \mu A$	$I_E = 0$
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	6.0			**6.0**			**Volts**	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	$I_E = 10\ \mu A$	$I_C = 0$
τ_s	**Charge Storage Time Constant** (Notes 6 and 7)		3.0	6.0		**3.0**	**6.0**	ns	$I_C = I_{B1} \approx 5.0$ mA	$I_{B2} \approx -5.0$ mA
t_{on}	**Turn On Time** (Note 7)		8.0	15		**6.0**	**12**	ns	$I_C \approx 10$ mA	$I_{B1} \approx 2.0$ mA
t_{off}	**Turn Off Time** (Note 7)		8.0	15		**6.0**	**12**	ns	$I_C \approx 10$ mA $I_{B2} \approx -1.0$ mA	$I_{B1} \approx 1.0$ mA
f_T	Gain-Bandwidth Product (f = 100 MHz)	600	800					MHz	$I_C = 5.0$ mA	$V_{CE} = 4.0$ V
f_T	**Gain-Bandwidth Product (f = 100 MHz)**				**600**	**800**		**MHz**	$I_C = 10$ mA	$V_{CE} = 4.0$ V

TYPICAL ELECTRICAL CHARACTERISTICS

COLLECTOR CHARACTERISTICS*



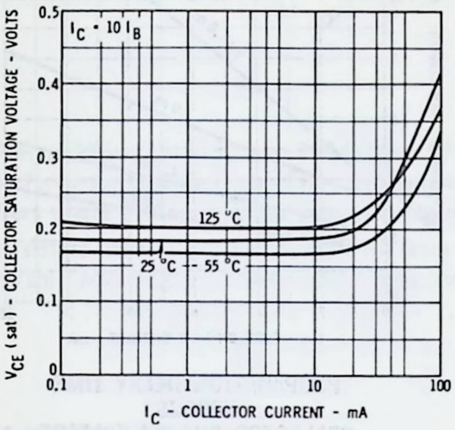
BASE CHARACTERISTICS*



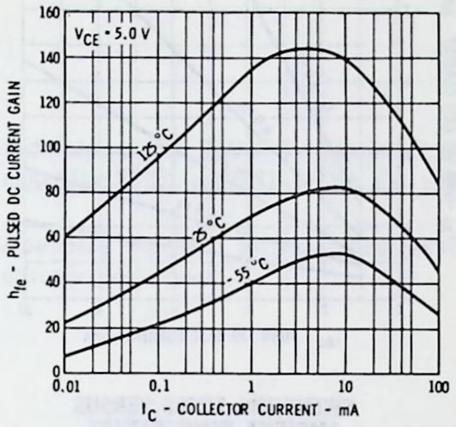
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

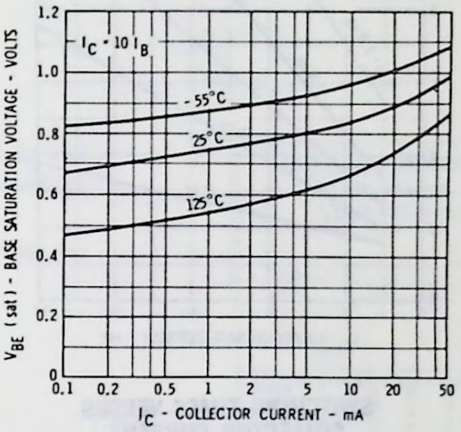
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



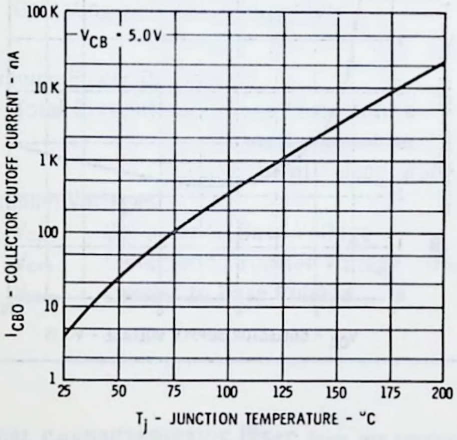
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



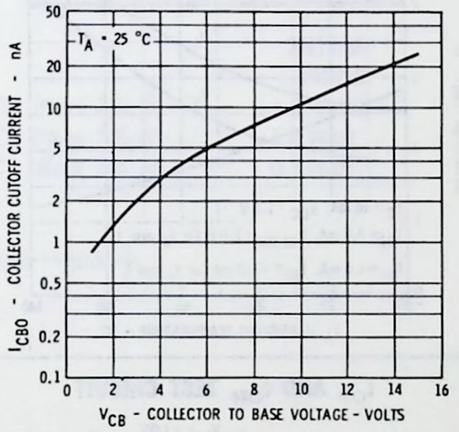
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



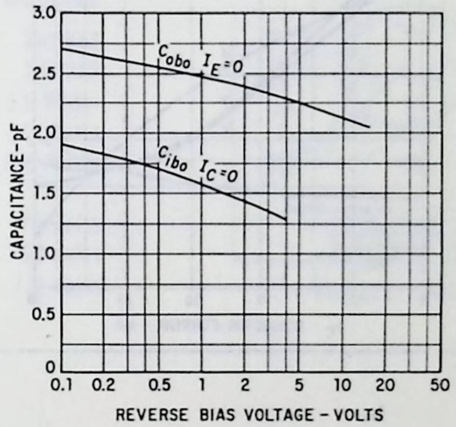
COLLECTOR CUTOFF CURRENT VERSUS JUNCTION TEMPERATURE



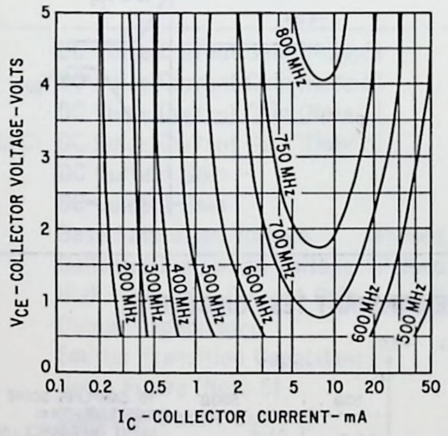
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



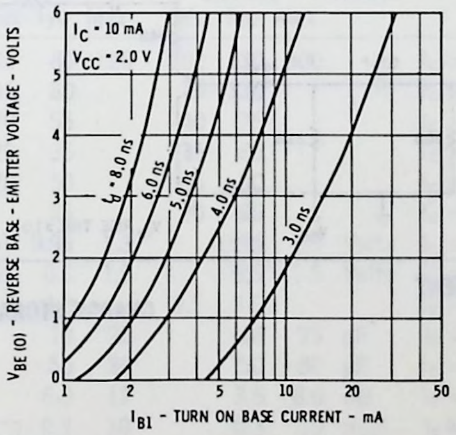
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



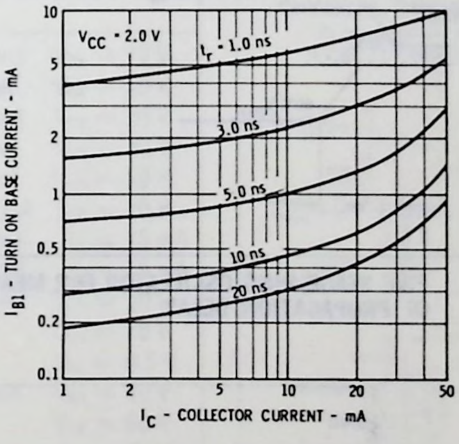
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



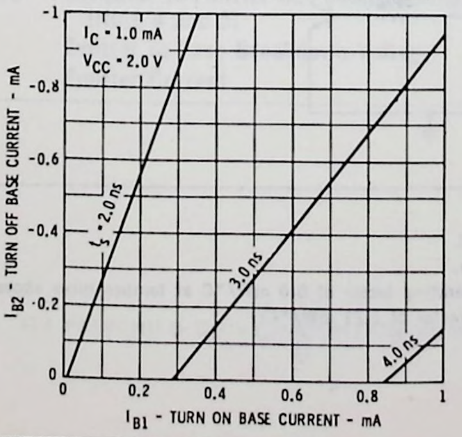
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE-EMITTER VOLTAGE



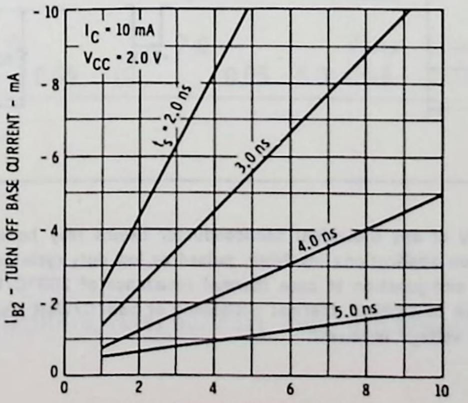
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



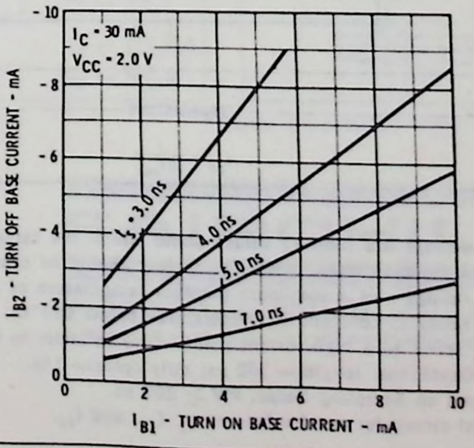
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

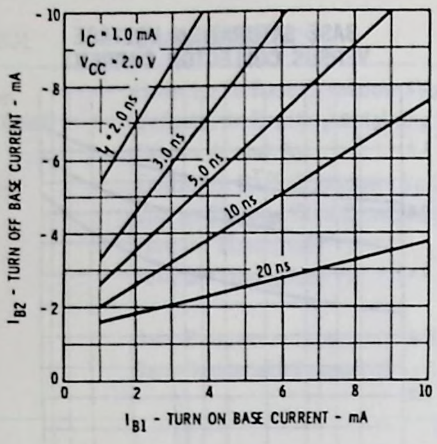


STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

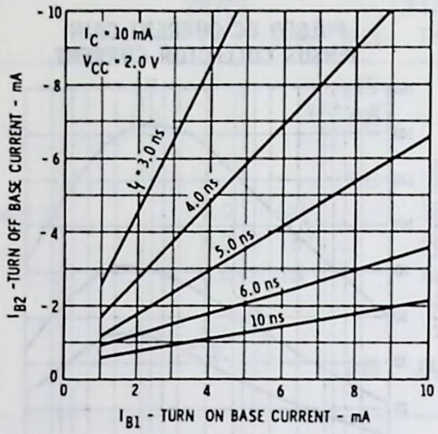


FAIRCHILD TRANSISTORS 2N709 • FT709

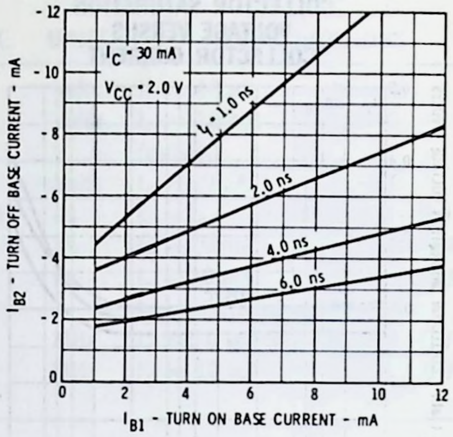
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



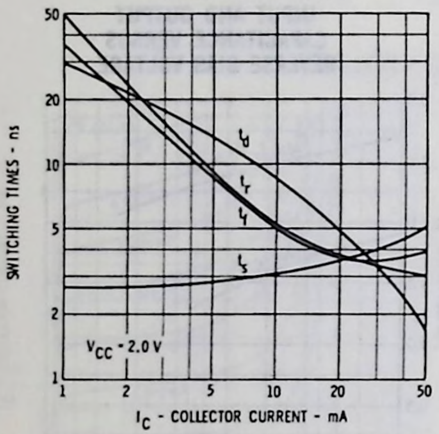
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



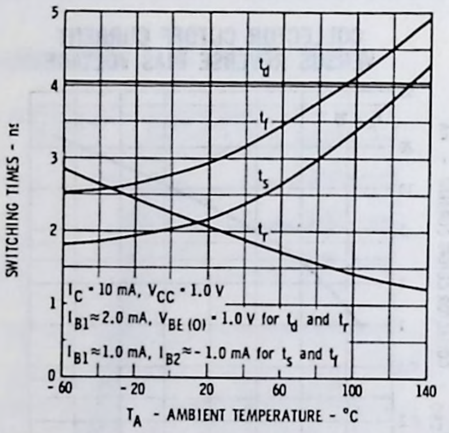
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



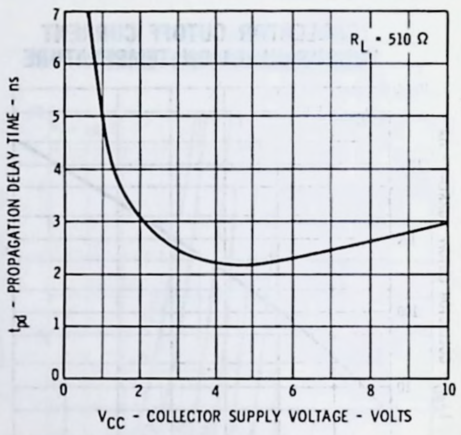
SWITCHING TIMES VERSUS COLLECTOR CURRENT



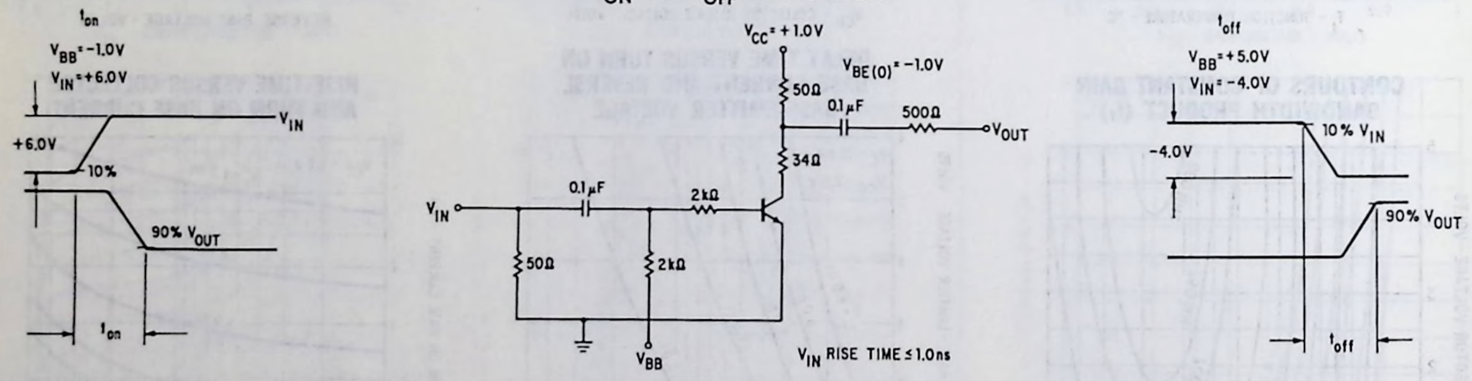
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE

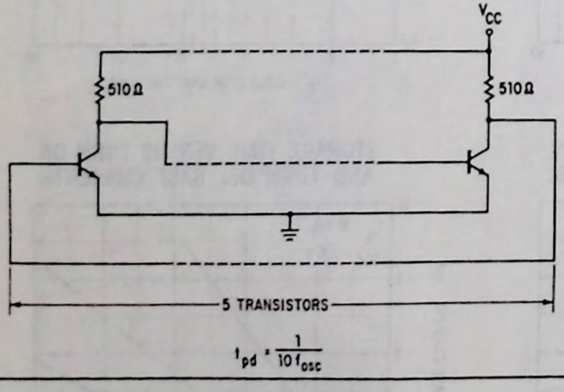


t_{ON} AND t_{OFF} TEST CIRCUIT



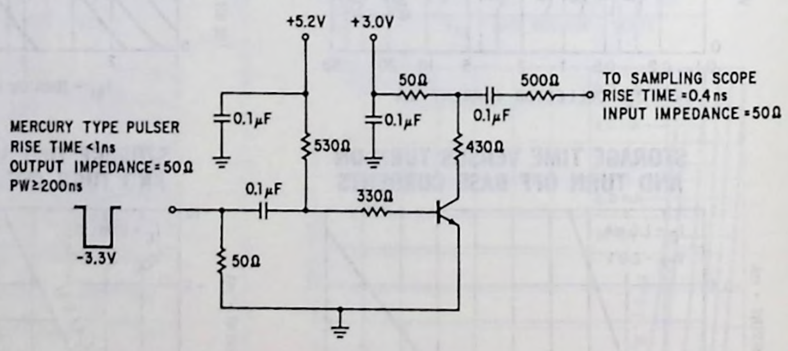
t_{on}
V_{BB} = -1.0V
V_{IN} = +6.0V
V_{IN}
+6.0V
10%
90% V_{OUT}
t_{on}
V_{CC} = +1.0V
$V_{BE(O)}$ = -1.0V
50Ω
0.1μF
500Ω
V_{OUT}
34Ω
V_{IN}
0.1μF
2kΩ
50Ω
2kΩ
V_{BB}
V_{IN} RISE TIME ≤ 1.0ns
t_{off}
V_{BB} = +5.0V
V_{IN} = -4.0V
10% V_{IN}
-4.0V
90% V_{OUT}
t_{off}

FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY



V_{CC}
510Ω
510Ω
5 TRANSISTORS
$t_{pd} = \frac{1}{10 f_{osc}}$

CHARGE STORAGE TIME CONSTANT TEST CIRCUIT



+5.2V
+3.0V
50Ω
500Ω
TO SAMPLING SCOPE
RISE TIME = 0.4 ns
INPUT IMPEDANCE = 50Ω
0.1μF
0.1μF
0.1μF
MERCURY TYPE PULSER
RISE TIME <1ns
OUTPUT IMPEDANCE = 50Ω
PW ≥ 200ns
530Ω
430Ω
0.1μF
330Ω
-3.3V
50Ω

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C at temperatures above 100° Power rating is constant at temperatures below 100°C). Junction to ambient thermal resistance of 583°C/Watt (derating factor of 1.71 mW/°C)

(4) Rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) Measured on Sampling Scope. PW ≥ 200 ns.

(7) See test circuit for exact values of I_C, I_{B1}, and I_{B2}.

2N718A · 2N1613 · 2N956 · 2N1711

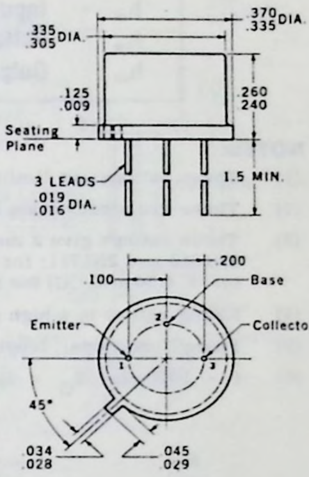
NPN UNIVERSAL AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* TRANSISTORS

The 2N718A , 2N956, 2N1613 , and 2N1711 are NPN double-diffused silicon PLANAR* transistors designed for use n high performance amplifier, oscillator and switching circuits. The 2N956 and 2N1711 are also used to advantage n amplifiers where low noise is an important factor.

These transistors provide useful current gain from the microampere region up to 500 milliamperes and have the many desirable advantages of the PLANAR structure and diffusion techniques.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 1.10 grams

2N1613 2N1711

BSOLUTE MAXIMUM RATINGS [Note 1]

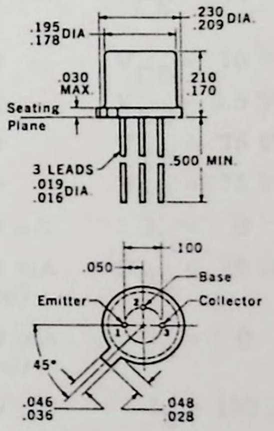
Maximum Temperatures				
Storage Temperature			−65°C to +300°C	
Operating Junction Temperature			200°C Maximum	
			2N718A **2N956**	**2N1613** **2N1711**
Maximum Power Dissipation				
Total Dissipation at Case Temperature	25°C	[Note 2 & 3]	1.8 Watts	3.0 Watts
at Case Temperature	100°C	[Note 2 & 3]	1.0 Watt	1.7 Watts
at Ambient Temperature	25°C	[Note 2 & 3]	0.5 Watt	0.8 Watt
Maximum Voltages				
V_{CBO} Collector to Base Voltage				75 Volts
V_{CER} Collector to Emitter Voltage	($R_{BE} \leq 10\,\Omega$)	[Note 4]		50 Volts
V_{EBO} Emitter to Base Voltage				7.0 Volts

LECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N718A 2N1613 Min.	Typ.	Max.	2N956 2N1711 Min.	Typ.	Max.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	40	80	120	100	130	300		$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	35	80		75	130			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	20	55		40	75			$I_C = 500$ mA	$V_{CE} = 10$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	20	35		35	65			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	20	50		35	80			$I_C = 0.1$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain		35		20	60			$I_C = 0.01$ mA	$V_{CE} = 10$ V
V_{BE} (sat)	Base Saturation Voltage [Pulsed, Note 5]		0.95	1.3		0.95	1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE} (sat)	Collector Saturation Voltage [Pulsed, Note 5]		0.6	1.5		0.5	1.5	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0	4.0		3.5	5.0			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{obo}	Output Capacitance		18	25		18	25	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{TE}	Emitter Transition Capacitance		50	80		50	80	pF	$I_C = 0$	$V_{EB} = 0.5$ V
NF	Noise Figure [Note 6]		6.0	12		3.5	8.0	dB	$I_C = 0.3$ mA	$V_{CE} = 10$ V
$_{CBO}$	Collector Cutoff Current		0.3	10		0.3	10	mμA	$I_E = 0$	$V_{CB} = 60$ V
$_{CBO}$ (150°C)	Collector Cutoff Current		0.4	10		0.4	10	μA	$I_E = 0$	$V_{CB} = 60$ V
BV_{CBO}	Collector to Base Breakdown Voltage	75			75			Volts	$I_C = 0.1$ mA	$I_E = 0$
V_{CER} (sust)	Collector to Emitter Sustaining Voltage [Note 4 and 5]	50			50			Volts	$I_C = 100$ mA (pulsed)	$R_{BE} \leq 10\,\Omega$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			7.0			Volts	$I_C = 0$	$I_E = 0.1$ mA
$_{EBO}$	Emitter Current		0.05	10		0.05	5.0	mμA	$I_C = 0$	$V_{EB} = 5.0$ V

2N718A 2N956

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

* Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

SMALL SIGNAL CHARACTERISTICS (f=1 kHz)

SYMBOL	CHARACTERISTICS	2N718A—2N1613			2N956—2N1711			UNITS	TEST CONDITIONS
		Min.	Typ.	Max.	Min.	Typ.	Max.		
h_{ib}	Input Resistance	24	27	34	24	27	34	Ohms	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
		4.0	6.3	8.0	4.0	6.3	8.0	Ohms	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio		0.7	3.0		1.2	5.0	$\times 10^{-4}$	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
			0.8	3.0		1.2	5.0	$\times 10^{-4}$	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain	30	55	100	50	115	200		$I_C = 1.0$ mA $V_{CE} = 5.0$ V
		35	70	150	70	135	300		$I_C = 5.0$ mA $V_{CE} = 10$ V
h_{ob}	Output Conductance	0.1	0.16	0.5	0.1	0.16	0.5	µmho	$I_C = 1.0$ mA $V_{CB} = 5.0$ V
		0.1	0.19	1.0	0.1	0.19	1.0	µmho	$I_C = 5.0$ mA $V_{CB} = 10$ V
h_{ie}	Input Resistance		2.2			4.4		k ohms	$I_C = 1.0$ mA $V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio		3.6			7.3		$\times 10^{-4}$	$I_C = 1.0$ mA $V_{CE} = 5.0$ V
h_{oe}	Output Conductance		12.5			23.8		µmho	$I_C = 1.0$ mA $V_{CE} = 5.0$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C) for the 2N1613 and 2N1711; for the 2N718A and 2N956 97.2°C/Watt (derating factor of 10.3 mW/°C). Junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the 2N1613 and 2N1711; for the 2N718A and 2N956 350°C/Watt (derating factor of 2.86 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 µsec; duty cycle ≤ 2%.

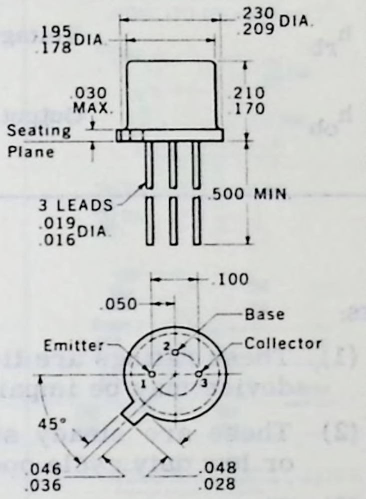
(6) f = 1000 Hz ; R_G = 510 Ω; 1.0 Hz bandwidth.

2N719A

NPN GENERAL PURPOSE HIGH VOLTAGE TYPE

DIFFUSED SILICON PLANAR TRANSISTOR

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

GENERAL DESCRIPTION - NPN double diffused silicon transistor designed for a wide variety of amplifier and high speed switching applications.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	+200°C Maximum

Maximum Power Dissipation

Total Dissipation at Case Temperature	25°C [Note 2 & 3]	1.8 Watts
at Case Temperature	100°C [Note 2 & 3]	1.0 Watt
at Ambient Temperature	25°C	0.5 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	120 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\ \Omega$) [Note 4]	80 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	60 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	20	60		$I_C = 150$ mA	$V_{CE} = 10$ V
V_{BE}(sat)	Base Saturation Voltage		0.9	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{CE}(sat)	Collector Saturation Voltage		1.2	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{BE}(sat)	Base Saturation Voltage		1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE}(sat)	Collector Saturation Voltage		5.0	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain f = 20 mc	2.0			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{ob}	Output Capacitance		15	pf	$I_E = 0$	$V_{CB} = 10$ V
C_{ib}	Input Capacitance		85	pf	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		10	mμA	$I_E = 0$	$V_{CB} = 75$ V
I_{CBO}(150°C)	Collector Cutoff Current		15	μA	$I_E = 0$	$V_{CB} = 75$ V
BV_{CBO}	Collector Breakdown Voltage	120		Volts	$I_C = 100\ \mu$A	$I_E = 0$
V_{CER}(sust)	Collector to Emitter [Note 4] Sustaining Voltage	80		Volts	$I_C = 100$ mA (pulsed)	$R_{BE} \leq 10\ \Omega$
V_{CEO}(sust)	Collector to Emitter [Note 4] Sustaining Voltage	60		Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter Breakdown Voltage	7.0		Volts	$I_C = 0$	$I_E = 100\ \mu$A
I_{EBO}	Emitter Cutoff Current		10	mμA	$I_C = 0$	$V_{EB} = 5.0$ V

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FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

SMALL SIGNAL CHARACTERISTICS (f = 1 Kc)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{fe}	Current Gain	15			I_C = 1.0 mA V_{CE} = 5.0 V
		25			I_C = 5.0 mA V_{CE} = 10 V
h_{ib}	Input Resistance	20	35	Ω	I_C = 1.0 mA V_{CB} = 5.0 V
			10	Ω	I_C = 5.0 mA V_{CB} = 10 V
h_{rb}	Voltage Feedback Ratio		2.5	$\times 10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
			5.0	$\times 10^{-4}$	I_C = 5.0 mA V_{CB} = 10 V
h_{ob}	Output Conductance	0.1	0.5	µmho	I_C = 1.0 mA V_{CB} = 5.0 V
			1.0	µmho	I_C = 5.0 mA V_{CB} = 10 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semi-conductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 97.3°C/watt (derating factor of 10.3 mw/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse conditions: length = 300 µsec; duty cycle ≤ 1%.

2N720A

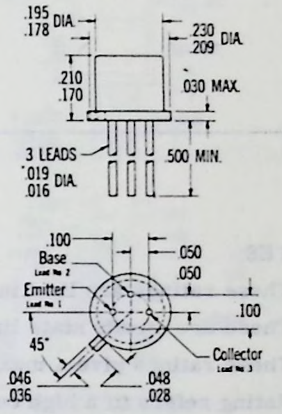
NPN HIGH-VOLTAGE GENERAL PURPOSE

DIFFUSED SILICON PLANAR*TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3108

GENERAL DESCRIPTION - NPN double diffused silicon general purpose transistor for a wide variety of amplifier and high speed switching applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.4 gram

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

Maximum Temperatures			
Storage Temperatures			-65°C to +300°C
Operating Junction Temperature			+200°C Maximum
Maximum Power Dissipation			
Total Dissipation at 25°C Case Temperature		(Notes 2 & 3)	1.8 Watts
at 100°C Case Temperature		(Notes 2 & 3)	1.0 Watt
at 25°C Ambient Temperature			0.5 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage		120 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\,\Omega$)	(Note 4)	100 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	80 Volts
V_{EBO}	Emitter to Base Voltage		7 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristics		Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain	(Note 5)	40	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain	(Note 5)	35			I_C = 10 mA	V_{CE} = 10 V
$h_{FE}(-55°C)$	DC Pulse Current Gain	(Note 5)	20			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain		20			I_C = 0.1 mA	V_{CE} = 10 V
$V_{BE}(sat)$	Base Saturation Voltage			0.9	Volts	I_C = 50 mA	I_B = 5 mA
$V_{CE}(sat)$	Collector Saturation Voltage			1.2	Volts	I_C = 50 mA	I_B = 5 mA
$V_{BE}(sat)$	Base Saturation Voltage			1.3	Volts	I_C = 150 mA	I_B = 15 mA
$V_{CE}(sat)$	Collector Saturation Voltage			5.0	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)		2.5			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance			15	pF	I_E = 0	V_{CB} = 10 V
C_{ibo}	Input Capacitance			85	pF	I_C = 0	V_{EB} = 0.5 V
I_{cbo}	Collector Cutoff Current	(Note 6)		10	mμA	I_E = 0	V_{CB} = 90 V
$I_{cbo}(150°C)$	Collector Cutoff Current	(Note 7)		15	μA	I_E = 0	V_{CB} = 90 V
BV_{CBO}	Collector Breakdown Voltage		120		Volts	I_C = 100 μA	I_E = 0
$V_{CER}(sust)$	Collector to Emitter Sustaining Voltage	(Note 4)	100		Volts	I_C = 100 mA (pulsed)	$R_{BE} \leq 10\ \Omega$
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage	(Note 4)	80		Volts	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter Breakdown Voltage		7		Volts	I_C = 0	I_E = 100 μA
I_{EBO}	Emitter Cutoff Current			10	mμA	I_C = 0	V_{BE} = 5 V

---

* Planar is a patented Fairchild process.

SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{fe}	Current Gain	30	100		I_E = 1 mA V_{CE} = 5 V
		45			I_E = 5 mA V_{CE} = 10 V
h_{ib}	Input Resistance	20	30	Ω	I_E = 1 mA V_{CB} = 5 V
		4	8	Ω	I_E = 5 mA V_{CB} = 10 V
h_{rb}	Voltage Feedback Ratio		1.25	$x10^{-4}$	I_E = 1 mA V_{CB} = 5 V
			1.50	$x10^{-4}$	I_E = 5 mA V_{CB} = 10 V
h_{ob}	Output Conductance		0.5	μmho	I_E = 1 mA V_{CB} = 5 V
			0.5	μmho	I_E = 5 mA V_{CB} = 10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 97.3°C/Watt (derating factor of 10.3 mW/°C
4. Rating refers to a high current point where collector-to-emitter voltage is lowest.
5. Pulse conditions: length = 300 μsec; duty cycle ≤1%.
6. The 90th percentile shall be no greater than 1 mμA.
7. The 90th percentile shall be no greater than 5 μA.

2N721 · 2N722 · 2N1131 · 2N1132

PNP GENERAL PURPOSE TYPE

DIFFUSED SILICON TRANSISTORS

These devices are PNP silicon transistors designed for use in high performance amplifiers, oscillators and some switching circuits. They perform at frequencies from DC to VHF.

ABSOLUTE MAXIMUM RATINGS (25°C) [Note 1]

Maximum Temperatures

Storage Temperature	**−65°C** to **+300°C**
Operating Junction Temperature	**175°C** Maximum
Lead Temperature (Soldering, No Time Limit)	**300°C** Maximum

Maximum Power Dissipation

	2N721 2N722	2N1131 2N1132
Total Dissipation at 25°C Case Temperature [Notes 2 & 3]	1.5 Watts	2.0 Watts
at 100°C Case Temperature [Notes 2 & 3]	0.75 Watt	1.0 Watt
at 25°C Ambient Temperature [Notes 2 & 3]	0.40 Watt	0.6 Watt

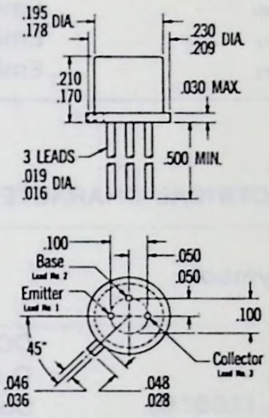
Maximum Voltages

V_{CBO}	Collector to Base Voltage	−50 Volts
V_{CER}	Collector to Emitter Voltage $R_{BE} \leq 10\ \Omega$ [Note 4]	−50 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−35 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N721 2N1131			2N722 2N1132					
Symbol	Characteristic	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain [Note 5]	20	26	45	30	45	90		$I_C = 150$ mA	$V_{CE} = -10$ V
V_{BE} (sat)	Base Saturation Voltage		−0.9	−1.3		−0.95	−1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE} (sat)	Collector Saturation Voltage		−1.0	−1.5		−1.0	−1.5	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain (f = 20 mc)	2.5	3.5		3.0	4.5			$I_C = 50$ mA	$V_{CE} = -10$ V
I_{CBO}	Collector Cutoff Current		0.01	1.0		0.01	1.0	μA	$I_E = 0$	$V_{CB} = -30$ V

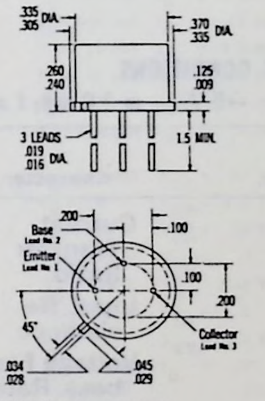
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N721 • 2N722

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N1131 • 2N1132

NOTES:

1) These ratings art limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 100°C/Watt for the 2N721 and 2N722 (derating factor of 10 mW/°C); for the 2N1131 and 2N1132, 75°C/Watt (derating factor of 13.3 mW/°C). Junction-to-ambient thermal resistance of 375°C/Watt (derating factor of 2.7 mW/°C) for the 2N721 and 2N722 ; for the 2N1131 and 2N1132, 250°C/Watt (derating factor 4.0 mW/°C).
4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	15	26			$I_C = 5.0$ mA	$V_{CE} = -10$ V
C_{ob}	Output Capacitance		31	45	pf	$I_E = 0$	$V_{CB} = -10$ V
I_{CBO} (150°C)	Collector Cutoff Current		2.0	100	µA	$I_E = 0$	$V_{CB} = -30$ V
BV_{CBO}	Collector to Base Breakdown Voltage	−50			Volts	$I_C = 100\mu A$	$I_E = 0$
V_{CER} (sust)	Collector to Emitter Sustaining Voltage	−50			Volts	$I_C = 100$mA (pulsed)	$R_{BE} \leq 10\ \Omega$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage	−35			Volts	$I_C = 100$mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Voltage	−5.0			Volts	$I_C = 0$	$I_E = 100\mu A$
I_{EBO}	Emitter Cutoff Current		0.1	100	µA	$I_C = 0$	$V_{EB} = -2.0$ V
C_{TE}	Emitter Transition Capacitance (For 2N721 only)		57	100	pf	$I_C = 0$	$V_{EB} = -0.5$ V
C_{TE}	Emitter Transition Capacitance (For 2N1131 only)		57	80	pf	$I_C = 0$	$V_{EB} = -0.5$ V

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	25	55			$I_C = 5.0$ mA	$V_{CE} = -10$ V
C_{ob}	Output Capacitance		31	45	pf	$I_E = 0$	$V_{CB} = -10$ V
I_{CBO} (150°C)	Collector Cutoff Current		2.0	100	µA	$I_E = 0$	$V_{CB} = -30$ V
BV_{CBO}	Collector to Base Breakdown Voltage	−50			Volts	$I_C = 100\mu A$	$I_E = 0$
V_{CER} (sust)	Collector to Emitter Sustaining Voltage	−50			Volts	$I_C = 100$mA (pulsed)	$R_{BE} \leq 10\ \Omega$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage	−35			Volts	$I_C = 100$mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Voltage	−5.0			Volts	$I_C = 0$	$I_E = 100\mu A$
I_{EBO}	Emitter Cutoff Current		0.1	100	µA	$I_C = 0$	$V_{EB} = -2.0$ V
C_{TE}	Emitter Transition Capacitance (For 2N722 only)		57	100	pf	$I_C = 0$	$V_{EB} = -0.5$ V
C_{TE}	Emitter Transition Capacitance (For 2N1132 only)		57	80	pf	$I_C = 0$	$V_{EB} = -0.5$ V

TEST CONDITIONS

$V_C = -5$ V; $I_C = 1.0$ mA; f = 1.0 kc

		2N721 • 2N1131			2N722 • 2N1132		
Sym.	Character.	Min.	Typ.	Max.	Min.	Typ.	Max.
h_{fe}	Current Transfer Ratio	15	34	50	25	57	100
h_{ib}	Input Resistance	25Ω	27	35Ω	25Ω	27	35Ω
h_{rb}	Voltage Feedback Ratio		1.3	8.0×10^{-4}		2.0	8.0×10^{-4}
h_{ob}	Output Conductance		0.3	1.0µmho		0.3	1.0µmho

TEST CONDITIONS

$V_C = -10$ V; $I_C = 5.0$ mA; f = 1.0 kc

		2N721 • 2N1131			2N722 • 2N1132		
Sym.	Character.	Min.	Typ.	Max.	Min.	Typ.	Max.
h_{fe}	Current Transfer Ratio	20	38		30	60	
h_{ib}	Input Resistance		6.2	10Ω		6.2	10Ω
h_{rb}	Voltage Feedback Ratio		1.3	8.0×10^{-4}		2.0	8.0×10^{-4}
h_{ob}	Output Conductance		0.5	5.0µmho		0.6	5.0µmh

2N743 • 2N744

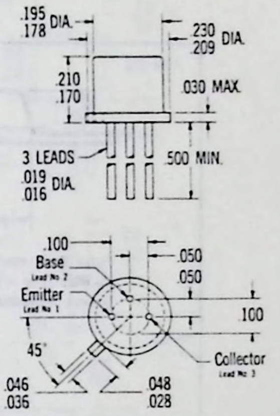
NPN HIGH-SPEED SATURATED SWITCHES

SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE
SEE FAIRCHILD 2N2369 A

GENERAL DESCRIPTION - The Fairchild 2N743 and 2N744 are NPN silicon PLANAR epitaxial transistors designed for use in high-speed saturated switching applications. They are suitable for most satellite and conventional, small-signal, RF, and digital type circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures		
Storage Temperature		-65°C to +300°C
Operating Junction Temperature		175°C Maximum
Lead Temperature (Soldering, 10 sec time limit)		230°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature	[Notes 2 and 3]	1.0 Watt
at 25°C Ambient Temperature	[Notes 2 and 3]	0.3 Watt
Maximum Voltages and Current		
V_{CBO} Collector to Base Voltage		20 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]		12 Volts
V_{EBO} Emitter to Base Voltage		5.0 Volts
I_C Collector Current		200 mA

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	2N743 Min.	2N743 Max.	2N744 Min.	2N744 Max.	Units	Test Conditions
h_{FE}	DC Current Gain	20	60	40	120		$I_C = 10$ mA $V_{CE} = 0.35$ V
h_{FE}(-55°C)	DC Current Gain	10		20			$I_C = 10$ mA $V_{CE} = 0.35$ V
h_{FE}	DC Pulse Current Gain [Note 5]	10		20			$I_C = 100$ mA $V_{CE} = 1.0$ V
h_{FE}	DC Current Gain	10		20			$I_C = 1.0$ mA $V_{CE} = 0.25$ V
V_{CE}(sat)	Collector Saturation Voltage ($T_A = 170$°C)		0.35		0.35	Volt	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage ($T_A = 170$°C)		1.0		1.0	Volt	$I_C = 100$ mA $I_B = 10$ mA
V_{BE}(sat)	Base Saturation Voltage	0.65	0.85	0.65	0.85	Volt	$I_C = 10$ mA $I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage ($T_A = -55$°C)		1.1		1.1	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage (pulsed) [Note 5]		1.5		1.5	Volts	$I_C = 100$ mA $I_B = 10$ mA
V_{BE}(sat)	Base Saturation Voltage (pulsed) [Note 5] $T_A = -55$°C		1.6		1.6	Volts	$I_C = 100$ mA $I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	9.0		9.0		dB	$I_C = 10$ mA $V_{CE} = 10$ V
C_{ob}	Output Capacitance		5.0		5.0	pF	$I_E = 0$ $V_{CB} = 5.0$ V
I_{CBO}	Collector Cutoff Current		1.0		1.0	μA	$I_E = 0$ $V_{CB} = 20$ V
I_{CES}	Collector Cutoff Current		1.0		1.0	μA	$V_{CE} = 20$ V $V_{BE} = 0$
I_{CE} (100°C)	Collector Cutoff Current		30		30	μA	$V_{CE} = 10$ V $V_{BE} = 0.35$ V
I_{CES}(170°C)	Collector Cutoff Current		100		100	μA	$V_{CE} = 20$ V $V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		10		10	μA	$I_C = 0$ $V_{EB} = 5.0$ V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	12		12		Volts	$I_C = 10$ mA (pulsed) $I_B = 0$
τ_s	Charge Storage Time Constant (see Fig. 1) [Note 6]		14		18	nsec	$I_C = I_{B_1} = I_{B_2} = 10$ mA
T_{on}	Turn On Time (see Figure 2) (Circuit Condition 2)		12		12	nsec	$I_C = 100$ mA, $I_{B_1} = 40$ mA, $I_{B_2} = 20$ mA
T_{on}	Turn On Time (see Figure 2) (Circuit Condition 1)		16		16	nsec	$I_C = 10$ mA, $I_{B_1} = 3.0$ mA, $I_{B_2} = 1.5$ mA
T_{off}	Turn Off Time (see Figure 2) (Circuit Condition 1)		24		24	nsec	$I_C = 10$ mA, $I_{B_1} = 3.0$ mA, $I_{B_2} = 1.5$ mA
T_{off}	Turn Off Time (see Figure 2) (Circuit Condition 2)		40		45	nsec	$I_C = 100$ mA, $I_{B_1} = 40$ mA, $I_{B_2} = 20$ mA

* Planar is a patented Fairchild process.

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 150°C/watt (derating factor of 6.7 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length ≤ 300 μsec; duty cycle ≤ 2%.
(6) Measured on Sampling Scope. PW ≥ 200 nsec.

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FIGURE 1

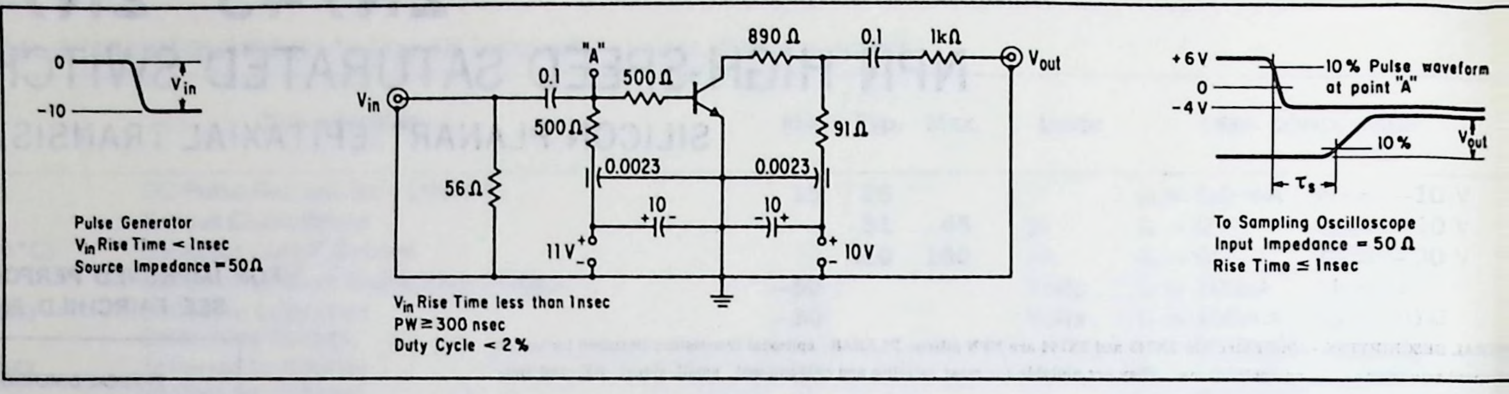
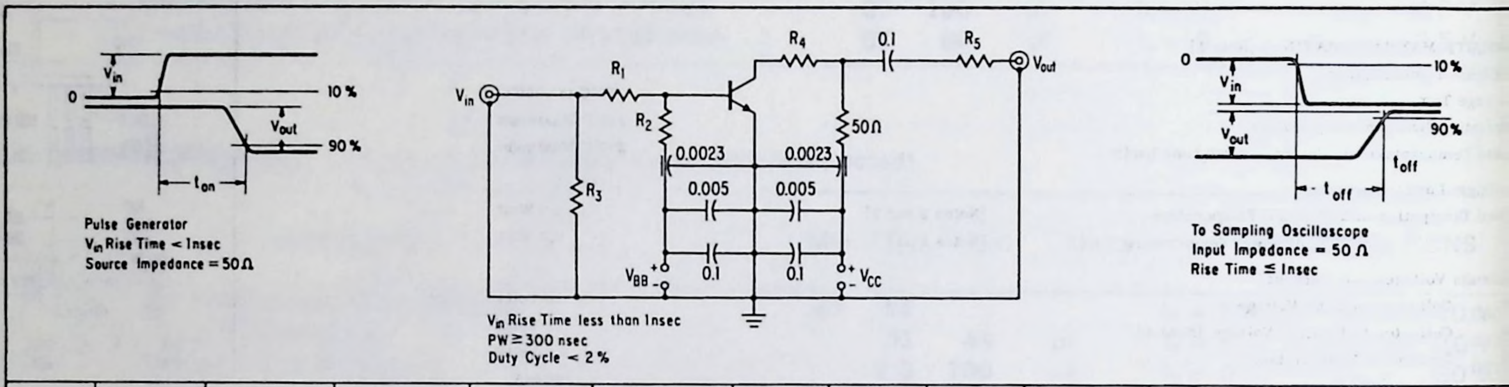

0
-10
V_{in}
Pulse Generator
V_{in} Rise Time < 1nsec
Source Impedance = 50Ω
V_{in}
56 Ω
0.1
"A"
500 Ω
500 Ω
0.0023
10
11 V
890 Ω
0.1
1kΩ
V_{out}
91 Ω
0.0023
10
10V
V_{in} Rise Time less than 1nsec
PW ≥ 300 nsec
Duty Cycle < 2%
+6 V
0
-4 V
10% Pulse waveform at point "A"
10%
V_{out}
τ_s
To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1nsec

FIGURE 2


V_{in}
0
10%
V_{out}
90%
t_{on}
Pulse Generator
V_{in} Rise Time < 1nsec
Source Impedance = 50Ω
V_{in}
R_1
R_2
R_3
V_{BB}
R_4
0.1
R_5
V_{out}
50Ω
0.0023
0.0023
0.005
0.005
0.1
0.1
V_{CC}
V_{in} Rise Time less than 1nsec
PW ≥ 300 nsec
Duty Cycle < 2%
0
V_{in}
10%
V_{out}
90%
t_{off}
t_{off}
To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1nsec

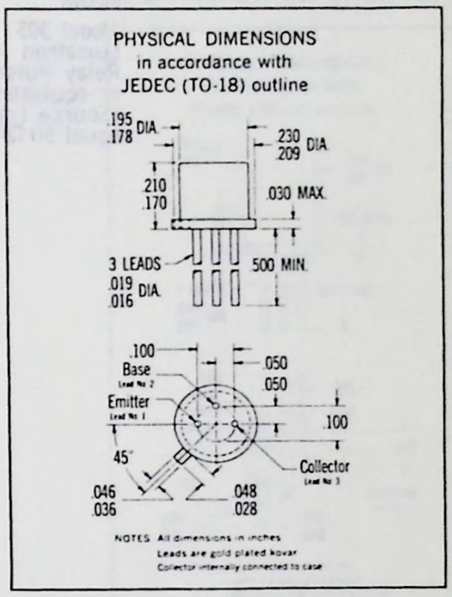
	I_C ma	$I_{B(1)}$ ma	$I_{B(2)}$ ma	$V_{BE(O)}$ V	V_{CC} V	$R_1 = R_2$ Ω	R_3 Ω	R_4 Ω	R_5 Ω	t_{on}		t_{off}	
										V_{BB}, V	V_{in}, V	V_{BB}, V	V_{in}, V
1	10	3	-1.5	-1.5	3.0	3.3 k	50	220	0	-3.0	15.0	12.0	-15.0
2	100	40	-20.0	-2.4	6.0	330	56	0	1 k	-4.5	20.0	15.3	-20.0

2N753

NPN MEDIUM SPEED SWITCH

SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N2369 A


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline
.195
.178 DIA
.230
.209 DIA
.210
.170
.030 MAX.
3 LEADS
.019
.016 DIA.
.500 MIN.
.100
Base
Lead No 2
.050
.050
Emitter
Lead No 1
.100
45°
Collector
Lead No 3
.046
.036
.048
.028
NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ENERAL DESCRIPTION - The Fairchild 2N753 is an NPN silicon PLANAR epitaxial transistor designed pecifically for high-speed, low-power saturated switching applications.

BSOLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures		
Storage Temperature		-65°C to + 175°C
Operating Junction Temperature		175°C Maximum
aximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)		0.3 Watt
aximum Voltages and Current		
V_{0CBO}	Collector to Base Voltage	25 Volts
V_{0CER}	Collector to Emitter Voltage (R_{BE} = 10 Ω) (Note 4)	20 Volts
V_{0CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{IEBO}	Emitter to Base Voltage	5.0 Volts
I_{CC}	Collector Current	50 mA

ECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain	40	120		I_C = 10 mA	V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage		0.6	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage	0.7	0.9	Volts	I_C = 10 mA	I_B = 1.0 mA
I_{CBO}	Collector Cutoff Current		0.5	μA	I_E = 0	V_{CB} = 15 V
I_{CBO}	Collector Cutoff Current		10	μA	I_E = 0	V_{CB} = 25 V
I_{CBO}(150°C)	Collector Cutoff Current		30	μA	I_E = 0	V_{CB} = 15 V
I_{CER}	Collector-Emitter Cutoff Current Resistance Return		10	μA	V_{CE} = 20 V	R_{BE} = 100 KΩ
I_{EBO}	Emitter Cutoff Current		10	μA	I_C = 0	V_{EB} = 5.0 V
C_{obo}	Output Capacitance (f = 1.0 MHz)		5.0	pF	I_E = 0	V_{CB} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0			I_E = -10 mA	V_{CE} = 10 V
BV_{CER}	Collector-Emitter Breakdown Voltage, Resistance Return (Note 4)	20		Volts	I_C = 10 mA (pulsed)	R_{BE} = 10 Ω
BV_{CEO}	Collector-Emitter Breakdown Voltage, Open Circuit (Note 4)	15		Volts	I_C = 10 mA (pulsed)	I_B = 0
τ_s	Charge Storage Time Constant (Note 5)		35	nsec	I_C = 10 mA	V_{CC} = 10 V
t_{on}	Turn On Time (Note 6)		40	nsec	V_{CC} = 3.0 V	R_L = 270 Ω
t_{off}	Turn Off Time (Note 6)		75	nsec	V_{CC} = 3.0 V	R_L = 270 Ω

TES:

* Planar is a patented Fairchild process.

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

Rating refers to a high current point where collector-to-emitter voltage is lowest.

R_L = 1 kΩ, I_{B1} = I_{B2} = 10 mA (see Figure 2)

I_{B1} = 3.0 mA, I_{B2} = 1.0 mA, $t_w \geq$ 400 nsec, duty cycle <2%, (see Figure 1).

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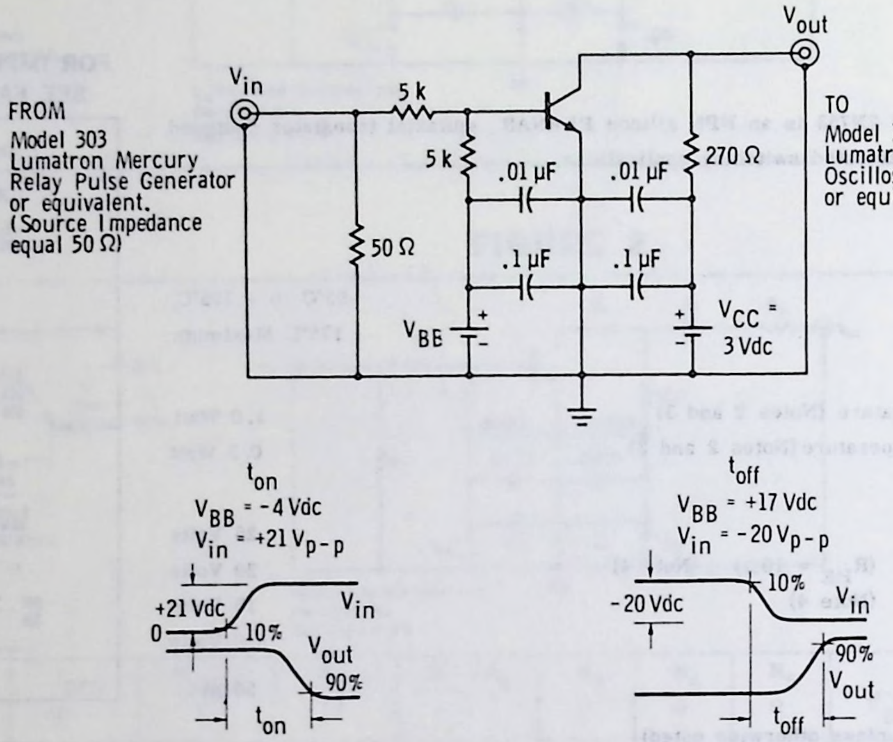
FIGURE 1

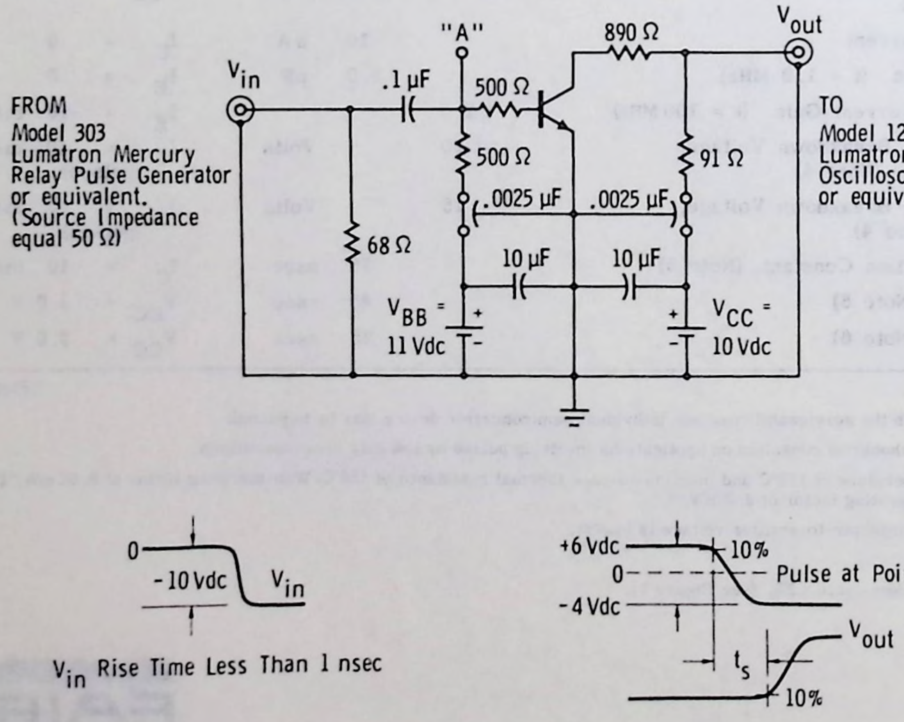
Turn-On and Turn-Off Circuit



V_in
FROM
Model 303
Lumatron Mercury
Relay Pulse Generator
or equivalent.
(Source Impedance
equal 50 Ω)
5 k
5 k
50 Ω
.01 µF
.01 µF
.1 µF
.1 µF
V_BB
V_CC = 3 Vdc
270 Ω
V_out
TO
Model 12 - AB
Lumatron Sampling
Oscilloscope
or equivalent
t_on
V_BB = -4 Vdc
V_in = +21 V_p-p
+21 Vdc
0
10%
V_in
V_out
90%
t_on
t_off
V_BB = +17 Vdc
V_in = -20 V_p-p
-20 Vdc
10%
V_in
90%
V_out
t_off

FIGURE 2

Storage Time Circuit



V_in
FROM
Model 303
Lumatron Mercury
Relay Pulse Generator
or equivalent.
(Source Impedance
equal 50 Ω)
.1 µF
"A"
500 Ω
500 Ω
68 Ω
.0025 µF
.0025 µF
890 Ω
91 Ω
10 µF
10 µF
V_BB = 11 Vdc
V_CC = 10 Vdc
V_out
TO
Model 12 - AB
Lumatron Sampling
Oscilloscope
or equivalent
0
-10 Vdc
V_in
V_in Rise Time Less Than 1 nsec
+6 Vdc
0
-4 Vdc
10%
Pulse at Point "A"
V_out
t_s
10%

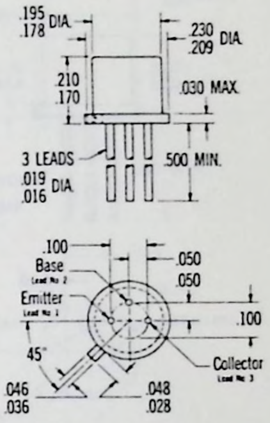
2N783

NPN HIGH-SPEED SWITCH

SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE
SEE FAIRCHILD 2N2369A

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ENERAL DESCRIPTION - The Fairchild 2N783 is an NPN silicon PLANAR epitaxial transistor designed specially for high-speed, low-power saturated switching applications.

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		-65°C to +300°C
Operating Junction Temperature		175°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.3 Watt
Maximum Voltages and Current		
V_{CBO} Collector to Base Voltage		40 Volts
V_{CER} Collector to Emitter Voltage (R_{BE} = 10 Ω)		20 Volts
V_{EBO} Emitter to Base Voltage		5.0 Volts
I_C Collector Current		200 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic		Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain		20	60		I_C = 10 mA	V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage			0.25	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage		0.7	0.9	Volts	I_C = 10 mA	I_B = 1.0 mA
I_{CBO}	Collector Cutoff Current			250	nA	I_E = 0	V_{CB} = 25 V
I_{CBO}(150°C)	Collector Cutoff Current			30	μA	I_E = 0	V_{CB} = 25 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)		2.0			I_C = 10 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance (f = 1.0 MHz)			3.5	pF	I_E = 0	V_{CB} = 10 V
t_s	Storage Time	(Note 4)		10	nsec	I_C = 10 mA	V_{CC} = 10 V
t_{on}	Turn On Time	(Note 5)		16	nsec	I_{B1} = 3.0 mA	I_{B2} = 1.0 mA
t_{off}	Turn Off Time	(Note 5)		30	nsec	I_{B1} = 3.0 mA	I_{B2} = 1.0 mA
BV_{CBO}	Collector to Base Breakdown Voltage		40		Volts	I_E = 0	I_C = 100 μA
BV_{CER}	Collector to Emitter Breakdown Voltage (R_{BE} = 10 Ω)		20		Volts	I_C = 1.0 mA	V_{BE} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage		5.0		Volts	I_C = 0	I_E = 100 μA

* Planar is a patented Fairchild process.

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

I_{B1} = 10 mA, I_{B2} = 10 mA, R_L = 1 kΩ, (see Figure 2).

V_{CC} = 3.0 V, R_L = 270 Ω, (see Figure 1).

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FIGURE 1

TURN-ON AND TURN-OFF CIRCUIT

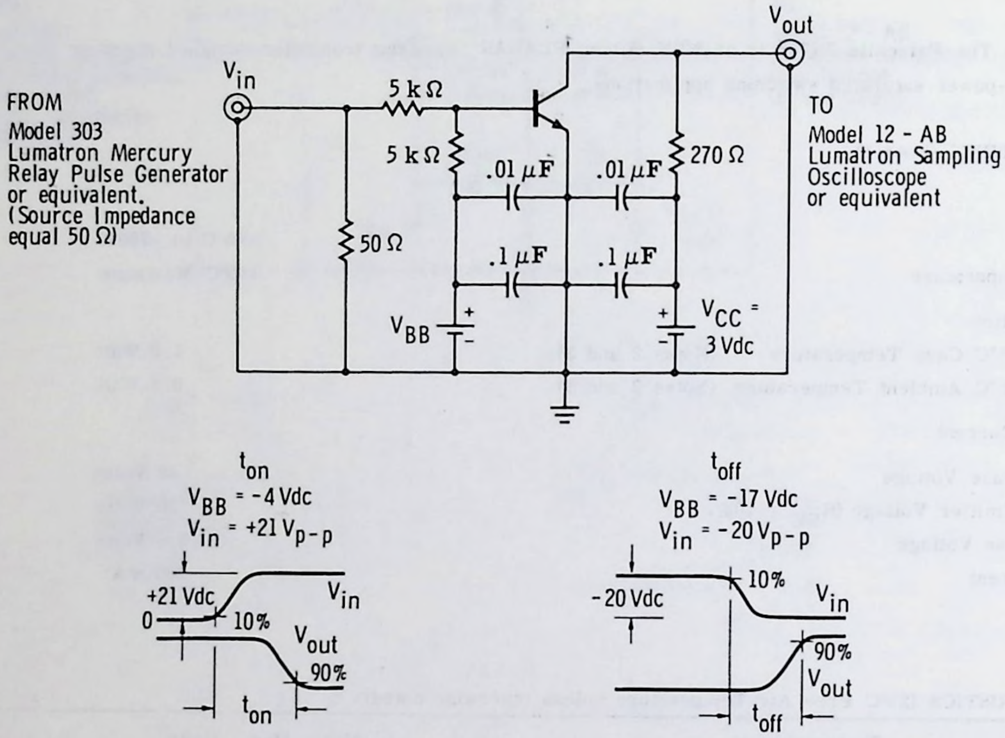
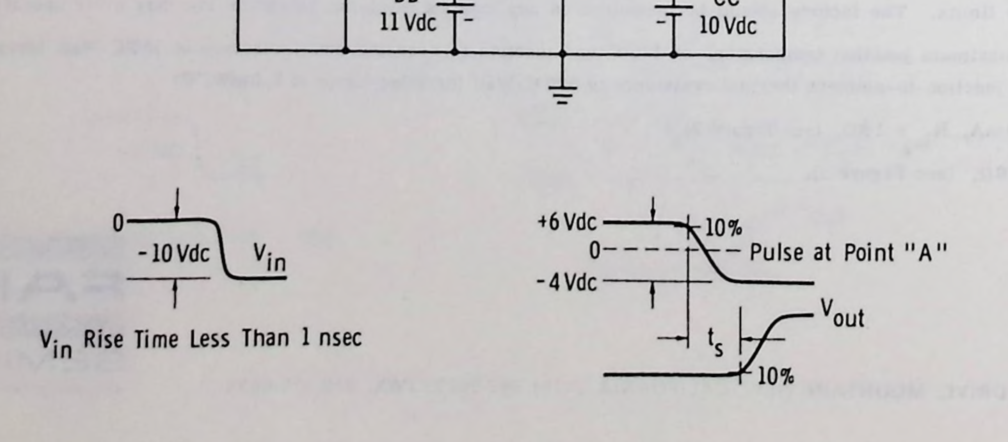

FROM
Model 303
Lumatron Mercury
Relay Pulse Generator
or equivalent.
(Source Impedance
equal 50 Ω)
V in
5 kΩ
5 kΩ
50 Ω
.01 μF
.01 μF
.1 μF
.1 μF
V BB
V CC = 3 Vdc
270 Ω
V out
TO
Model 12 - AB
Lumatron Sampling
Oscilloscope
or equivalent
t on
V BB = -4 Vdc
V in = +21 V p-p
+21 Vdc
0
10%
V in
V out
90%
t on
t off
V BB = -17 Vdc
V in = -20 V p-p
-20 Vdc
10%
V in
90%
V out
t off

FIGURE 2

STORAGE TIME CIRCUIT


FROM
Model 303
Lumatron Mercury
Relay Pulse Generator
or equivalent.
(Source Impedance
equal 50 Ω)
V in
.1 μF
"A"
500 Ω
500 Ω
68 Ω
.0025 μF
.0025 μF
10 μF
10 μF
V BB = 11 Vdc
V CC = 10 Vdc
890 Ω
91 Ω
V out
TO
Model 12 - AB
Lumatron Sampling
Oscilloscope
or equivalent
0
-10 Vdc
V in
V in Rise Time Less Than 1 nsec
+6 Vdc
0
-4 Vdc
10%
Pulse at Point "A"
V out
t s
10%

2N834

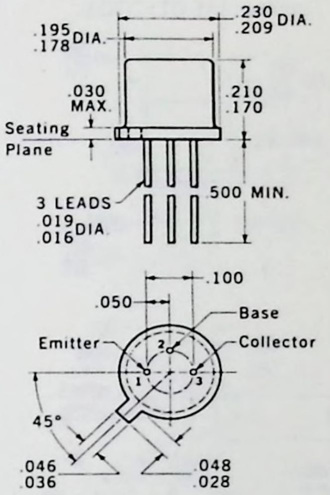
NPN HIGH-SPEED SWITCH

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N2369

GENERAL DESCRIPTION – The Fairchild 2N834 is an NPN silicon PLANAR epitaxial transistor dessigned for high-speed saturated switching applications. It is suitable for most satellite and conventional, small signal, RF, and digital type circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +175°C
Operating Junction Temperature	175°C Maximum
Lead Temperature (Soldering, 10 sec time limit)	240°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	[Notes 2 and 3]	1.0 Watt
at 25°C Ambient Temperature	[Notes 2 and 3]	0.3 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 4]	25			I_C = 10 mA	V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage		0.25	Volt	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.4	Volt	I_C = 50 mA	I_B = 5.0 V
V_{BE}(sat)	Base Saturation Voltage		0.9	Volt	I_C = 10 mA	I_B = 1.0 mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	3.5			I_C = 10 mA	V_{CE} = 15 V
f_T	Gain-Bandwidth Product (f = 100 mc)	350		mc	I_C = 10 mA	V_{CE} = 15 V
I_{CBO}	Collector Cutoff Current		0.5	µA	I_E = 0	V_{CB} = 20 V
I_{CBO} (150°C)	Collector Cutoff Current		30	µA	I_E = 0	V_{CB} = 20 V
I_{CES}	Collector Cutoff Current		10	µA	V_{CE} = 30 V	V_{BE} = 0
C_{ob}	Output Capacitance		4.0	pf	I_E = 0	V_{CB} = 10 V
τ_s	Charge Storage Time Constant		25	nsec	See Figure 1	
T_{on}	Turn On Time		35	nsec	See Figure 2	
T_{off}	Turn Off Time		75	nsec	See Figure 2	
BV_{CBO}	Collector to Base Breakdown Voltage	40		Volts	I_C = 100 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	I_E = 100 µA	I_C = 0

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NOTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

4) Pulse Conditions: length ≤ 300 µsec; duty cycle ≤ 2%.

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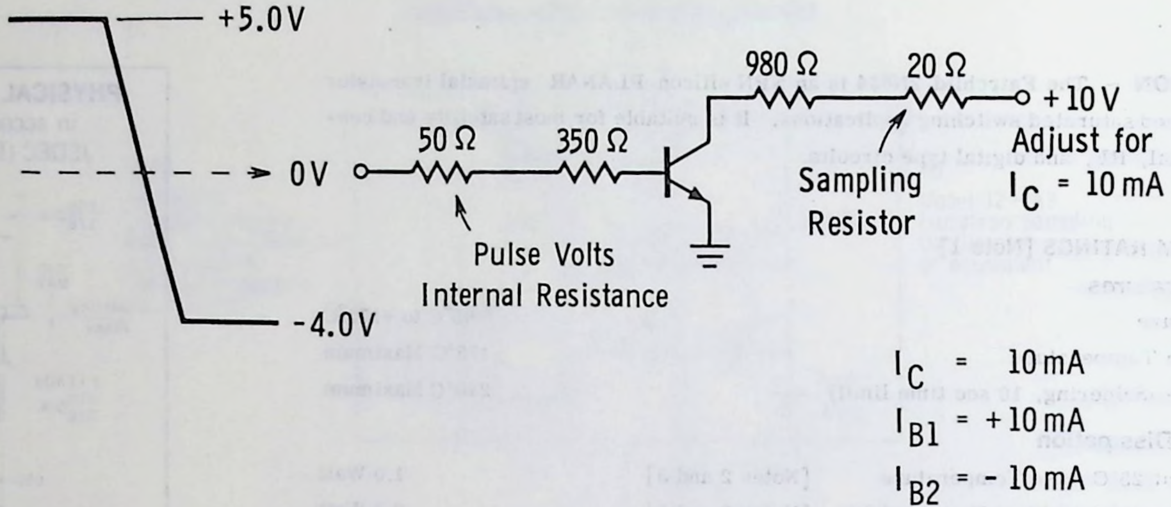

+5.0 V
0 V
-4.0 V
50 Ω
350 Ω
Pulse Volts
Internal Resistance
980 Ω
20 Ω
+10 V
Sampling
Resistor
Adjust for
I_C = 10 mA
I_C = 10 mA
I_{B1} = +10 mA
I_{B2} = - 10 mA

Figure 1

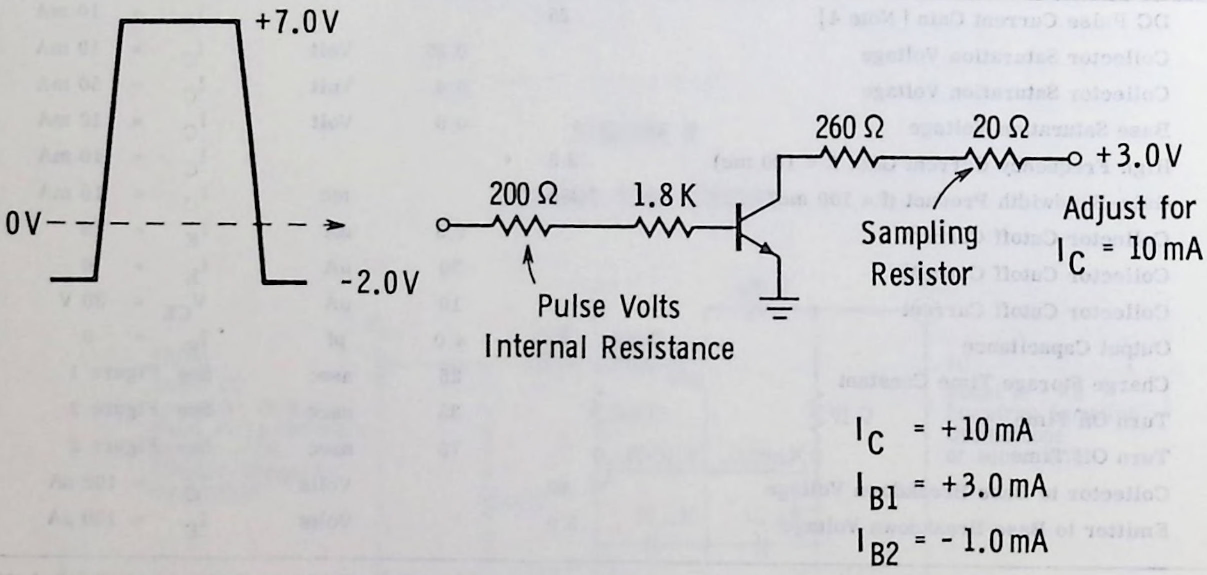

+7.0 V
0 V
-2.0 V
200 Ω
1.8 K
Pulse Volts
Internal Resistance
260 Ω
20 Ω
+3.0 V
Sampling
Resistor
Adjust for
I_C = 10 mA
I_C = +10 mA
I_{B1} = +3.0 mA
I_{B2} = - 1.0 mA

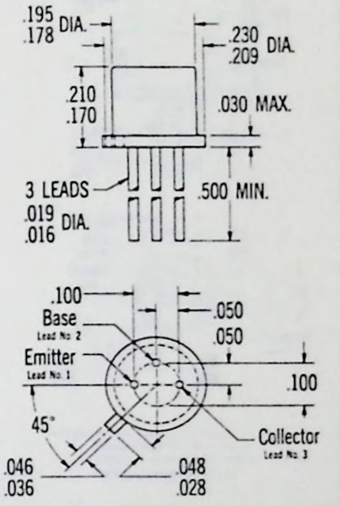
Figure 2

2N835
NPN HIGH-SPEED SWITCH
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N2369A

ENERAL DESCRIPTION - The Fairchild 2N835 is an NPN silicon PLANAR epitaxial transistor designed specifically or high-speed, low-power saturated switching applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	-65°C to +175°C
Operating Junction Temperature	175°C Maximum
Lead Temperature (1/16" ± 1/32" from case for 10 sec)	240°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.3 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	25 Volts
V_{CES} Collector to Emitter Voltage	20 Volts
V_{CEO} Collector to Emitter Voltage	20 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts
I_C Collector Current	200 mA

LECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain	20			I_C = 10 mA	V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage		0.3	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage		0.9	Volts	I_C = 10 mA	I_B = 1.0 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0			I_C = 10 mA	V_{CE} = 15 V
f_T	Gain-Bandwidth Product	300		MHz	I_C = 10 mA	V_{CE} = 15 V
I_{CBO}	Collector Cutoff Current		0.5	μA	I_E = 0	V_{CB} = 20 V
I_{CBO}(150°C)	Collector Cutoff Current		30	μA	I_E = 0	V_{CB} = 20 V
I_{CES}	Collector Cutoff Current		10	μA	V_{CE} = 20 V	V_{BE} = 0
I_{EBO}	Emitter Cutoff Current		10	μA	I_C = 0	V_{EB} = 3.0 V
C_{ob}	Output Capacitance		4.0	pf	I_E = 0	V_{CB} = 10 V
T_{on}	Turn On Time		20	nsec	See Figure 2	
T_{off}	Turn Off Time		35	nsec	See Figure 2	
τ_s	Charge Storage Time Constant		35	nsec	See Figure 1	
BV_{CBO}	Collector to Base Breakdown Voltage	25		Volts	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		Volts	I_E = 10 μA	I_C = 0

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 150°C/watt (derating factor of 6.67 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).

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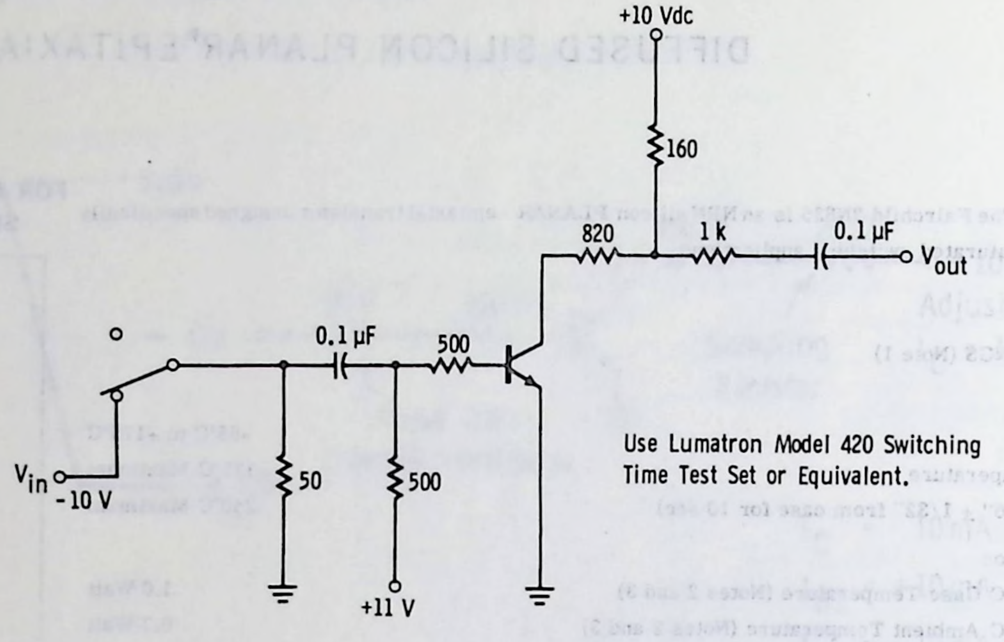
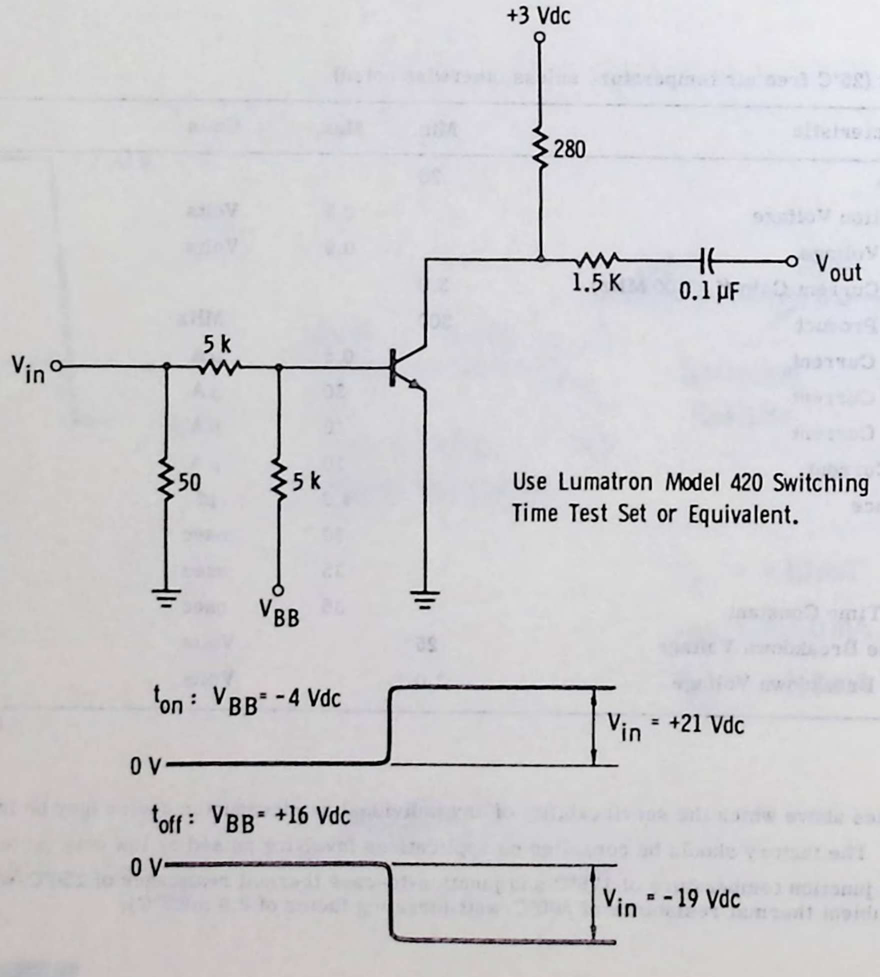
FIGURE 1—Charge storage time constant measurement circuit


+10 Vdc
160
820
1 k
0.1 µF
V_{out}
0.1 µF
500
V_{in}
-10 V
50
500
+11 V

Use Lumatron Model 420 Switching Time Test Set or Equivalent.

FIGURE 2—Turn-on and turn-off time measurement circuit


+3 Vdc
280
1.5 K
0.1 µF
V_{out}
5 k
V_{in}
50
5 k
V_{BB}
t_{on} : V_{BB} = -4 Vdc
0 V
V_{in} = +21 Vdc
t_{off} : V_{BB} = +16 Vdc
0 V
V_{in} = -19 Vdc

Use Lumatron Model 420 Switching Time Test Set or Equivalent.

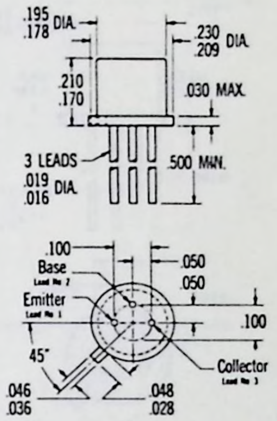
2N869

PNP NON-SATURATING SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR TRANSISTOR

ENERAL DESCRIPTION - The 2N869 is a double diffused silicon PNP planar ransistor packaged in the JEDEC TO-18 outline. It is designed as a high-frequency eneral-purpose transistor and is used to advantage in complementary type circuits ith the 2N916. Typical f_T is 150 mc.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight 0.4 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	[Note 2 & 3]	1.2 Watts
at 100°C Case Temperature	[Note 2 & 3]	.68 Watt
at 25°C Ambient Temperature		.36 Watt

Maximum Voltages

V_{CBO}	– Collector to Base Voltage	-25 Volts
V_{CER}	– Collector to Emitter Voltage ($R_{BE} \leq 10\ \Omega$) [Note 4]	-25 Volts
V_{CEO}	– Collector to Emitter Voltage [Note 4]	-18 Volts
V_{EBO}	– Emitter to Base Voltage	-5.0 Volts

LECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain [Note 5]	20	120		$I_C = 10$ mA	$V_{CE} = -5.0$ V
V_{BE}(sat)	Base Saturation Voltage		-1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage		-1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
h_{fe}	High Frequency Current Gain f = 100 mc	1.0			$I_C = 10$ mA	$V_{CE} = -15$ V
C_{ob}	Output Capacitance		9.0	pf	$I_E = 0$	$V_{CB} = -10$ V
C_{TE}	Emitter Transition Capacitance		11	pf	$I_C = 0$	$V_{EB} = -0.5$ V
I_{CBO}	Collector Cutoff Current		10	mμA	$I_E = 0$	$V_{CB} = -15$ V
I_{CBO}(150°C)	Collector Cutoff Current		25	μA	$I_E = 0$	$V_{CB} = -15$ V
BV_{CBO}	Collector to Base Breakdown Voltage [Note 4]	-25		Volts	$I_C = 10\ \mu$A	$I_E = 0$
V_{CER}(sust)	Collector to Emitter Sustaining Voltage [Note 4]	-25		Volts	$I_C = 30$ mA (pulsed)	$R_{BE} \leq 10\ \Omega$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		Volts	$I_C = 0$	$I_E = 10\ \mu$A

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NOTES:

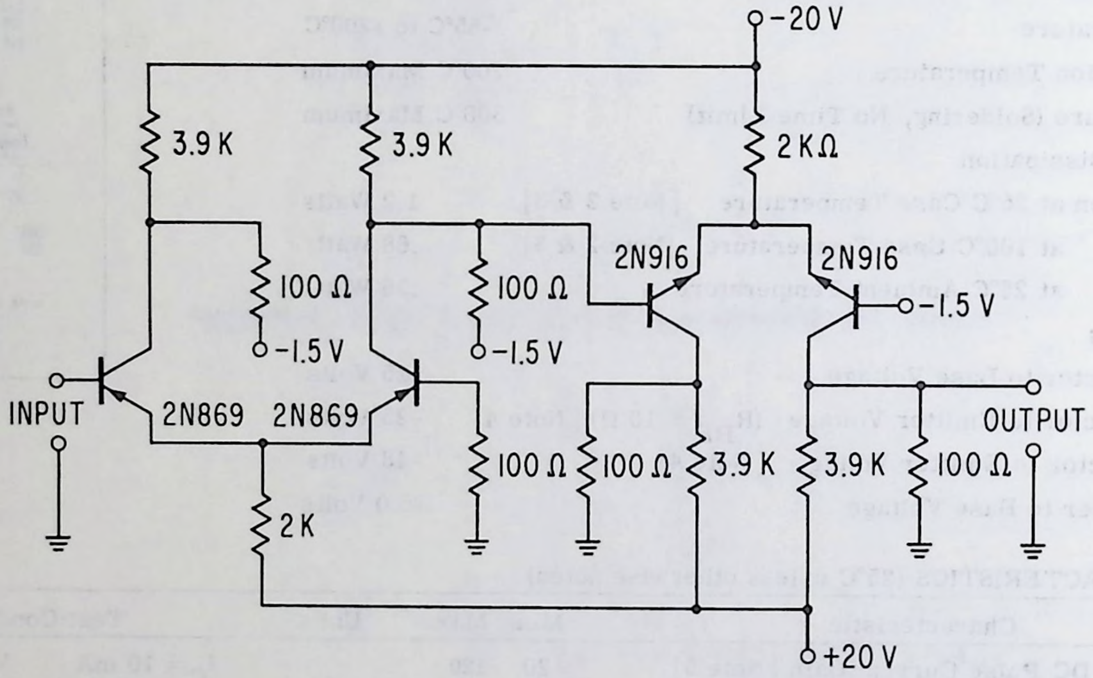
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146 °C/Watt (derating factor of 6.85 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle ≤ 1%.


-20 V
3.9 K
3.9 K
2 KΩ
2N916
2N916
100 Ω
100 Ω
-1.5 V
-1.5 V
-1.5 V
INPUT
2N869
2N869
OUTPUT
100 Ω
100 Ω
3.9 K
3.9 K
100 Ω
2 K
+20 V

COMPLEMENTARY HIGH SPEED NON-SATURATED
STEERING LOGIC CURRENT

t_{pd} < 5 nsec/stage

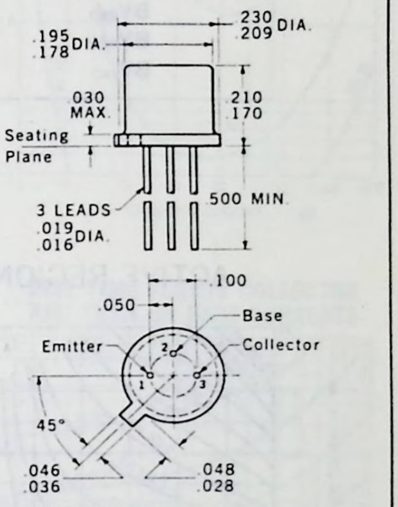
2N869A

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

The **2N869A** is a 550 mc PNP diffused silicon PLANAR epitaxial transistor designed for saturated and non-saturated switching circuits requiring up to 200 milliamperes of collector current. It is also suitable for most small-signal RF amplifier applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATING [Note 1]

Maximum Temperatures

Storage Temperature	**−65°C** to **+200°C**
Operating Junction Temperature	**200°C** Maximum
Lead Temperature (Soldering, 60 sec time limit)	**300°C** Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	**1.2** Watts
at 100°C Case Temperature [Notes 2 and 3]	**0.68** Watt
at 25°C Ambient Temperature [Notes 2 and 3]	**0.36** Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	**−25** Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	**−18** Volts
V_{EBO}	Emitter to Base Voltage	**−5.0** Volts
I_C	Collector Current	**200** mA

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	**40**	**75**	**120**		$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**30**	**67**			$I_C = 10$ mA	$V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**25**	**30**			$I_C = 100$ mA	$V_{CE} = -1.0$ V
V_{CE} (sat)	Collector Saturation Voltage		**−0.07**	**−0.15**	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.1**	**−0.2**	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.28**	**−0.5**	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	**4.0**	**5.5**			$I_C = 10$ mA	$V_{CE} = -15$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	**−18**			Volts	$I_C = 10$ mA (pulsed	$I_B = 0$
t_{on}	Turn On Time [Note 6]		**23**	**50**	nsec	$I_C \approx 30$ mA	$I_{B1} \approx 1.5$ mA
t_{off}	Turn Off Time [Note 6]		**34**	**80**	nsec	$I_C \approx 30$ mA	$I_{B1} \approx 1.5$ mA $I_{B2} \approx -1.5$ mA

Additional Electrical Characteristics on page 2.

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NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C); junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW°/C).
(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

FAIRCHILD
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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

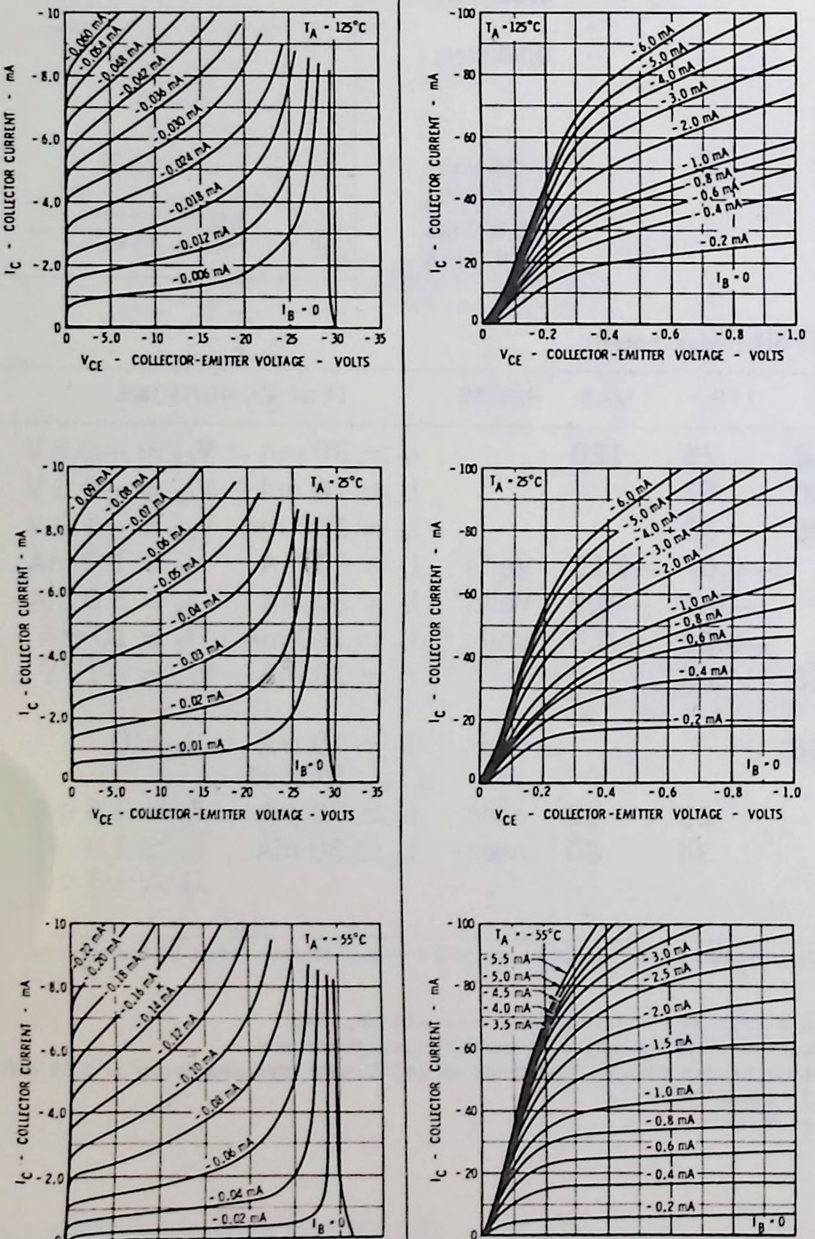
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	40	95	120		$I_C = 10$ mA	$V_{CE} = -5.0$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	17	43			$I_C = 30$ mA	$V_{CE} = -0.5$ V
V_{BE} (sat)	Base Saturation Voltage	−0.78	−0.92	−0.98	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Base Saturation Voltage	−0.85	−1.1	−1.2	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE} (sat)	Base Saturation Voltage		−1.4	−1.7	Volts	$I_C = 100$ mA	$I_B = 10$ mA
I_{CES}	Collector Reverse Current		0.05	10	nA	$V_{CE} = -15$ V	$V_{BE} = 0$
I_{CBO} (150°C)	Collector Cutoff Current		0.1	25	μA	$V_{CB} = -15$ V	$I_E = 0$
C_{ob}	Output Capacitance		3.0	6.0	pf	$V_{CB} = -5.0$ V	$I_E = 0$
C_{TE}	Emitter Transition Capacitance		3.8	6.0	pf	$V_{EB} = -0.5$ V	$I_C = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−25			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−25			Volts	$I_C = 10$ μA	$V_{EB} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	$I_E = 10$ μA	$I_C = 0$

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

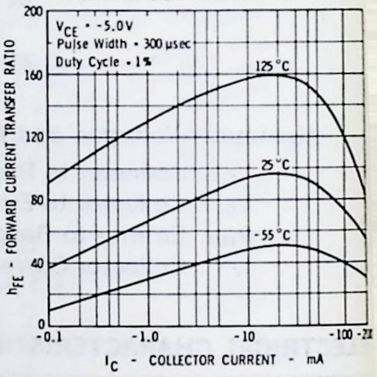
ACTIVE REGION

SATURATION REGION

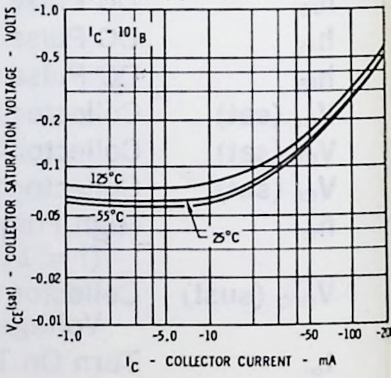


* Single family characteristics on Transistor Curve Tracer

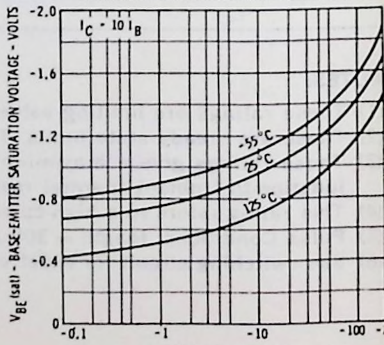
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

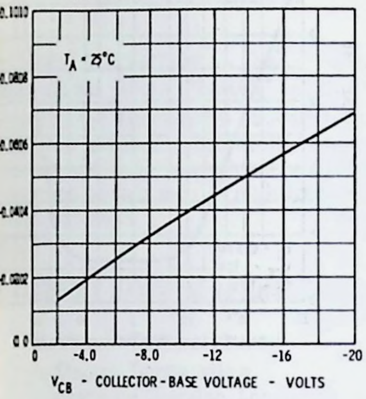


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

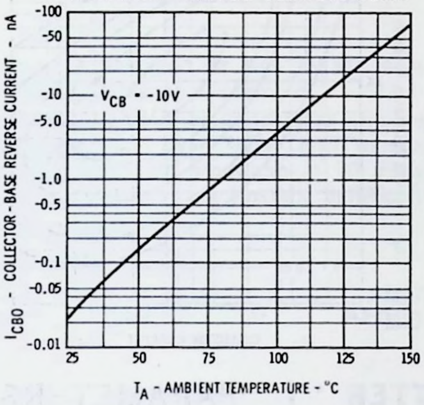


TYPICAL ELECTRICAL CHARACTERISTICS

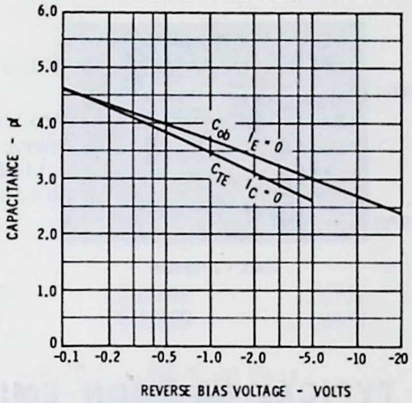
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



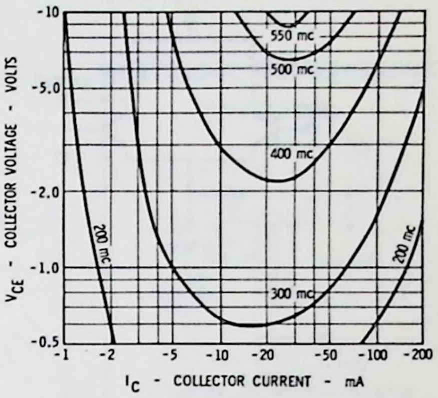
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



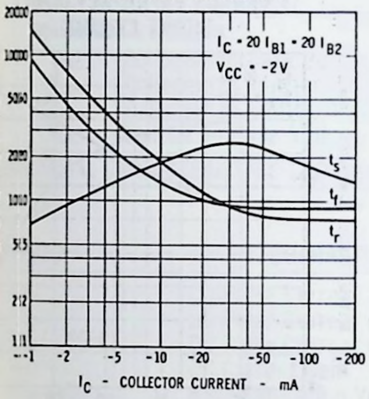
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



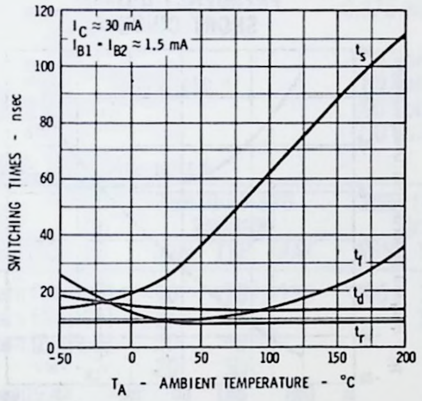
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



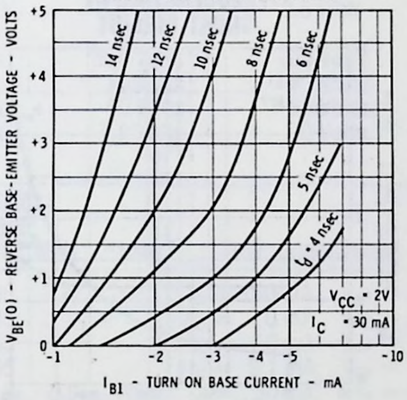
SWITCHING TIMES VERSUS COLLECTOR CURRENT



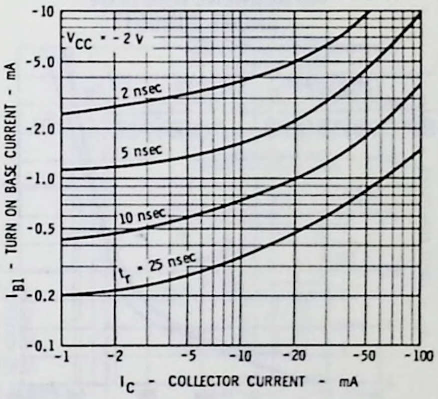
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



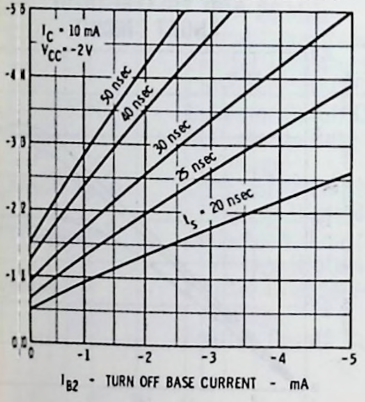
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



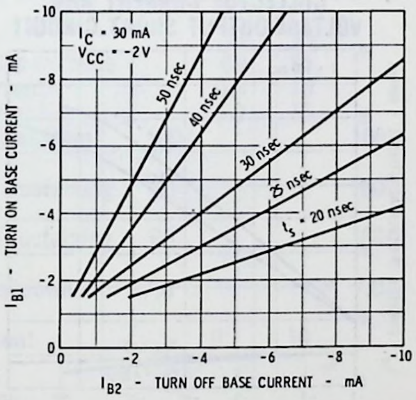
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



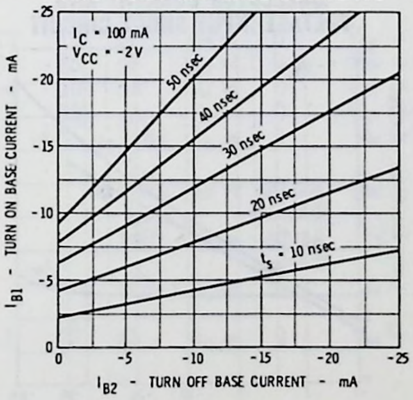
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



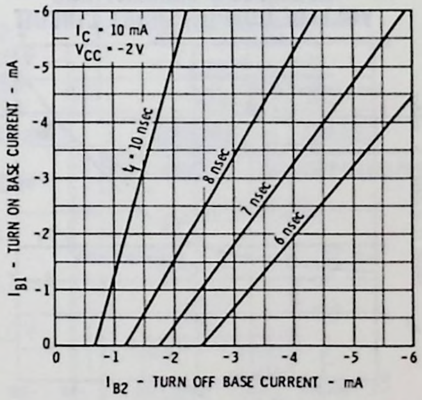
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



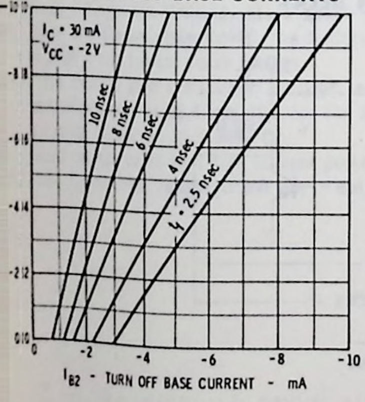
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



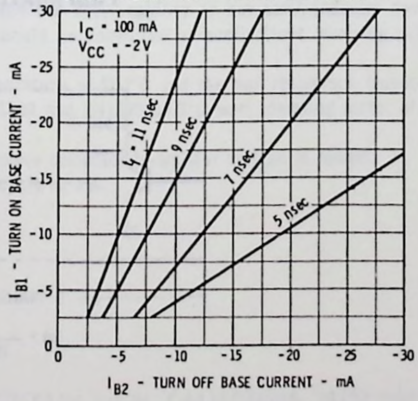
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



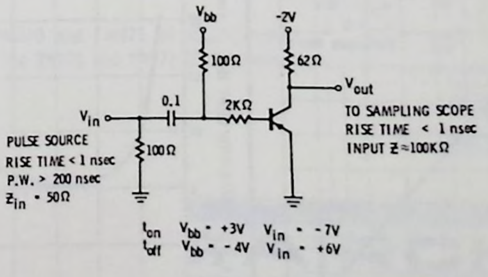
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

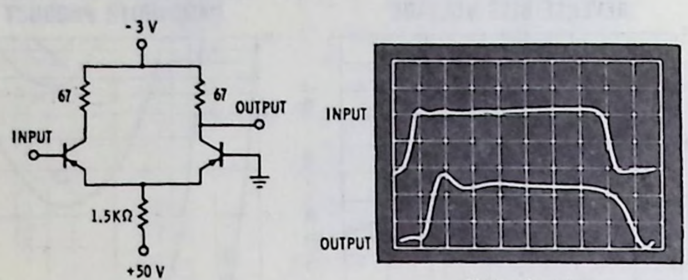


SWITCHING TIME TEST CIRCUIT


V_{bb}
-2V
100Ω
62Ω
V_{out}
0.1
2KΩ
V_{in}
100Ω
TO SAMPLING SCOPE
RISE TIME < 1 nsec
INPUT Z ≈ 100KΩ
PULSE SOURCE
RISE TIME < 1 nsec
P.W. > 200 nsec
Z_{in} = 50Ω
t_{on} V_{bb} = +3V V_{in} = -7V
t_{off} V_{bb} = -4V V_{in} = +6V

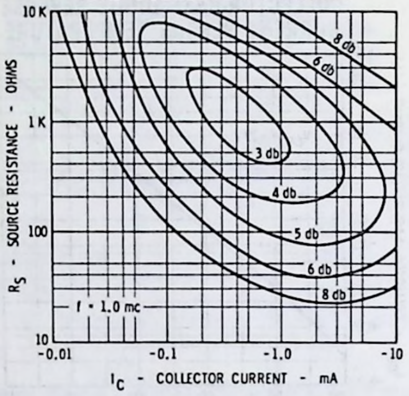
TYPICAL ELECTRICAL CHARACTERISTICS

NON SATURATED SWITCHING PERFORMANCE

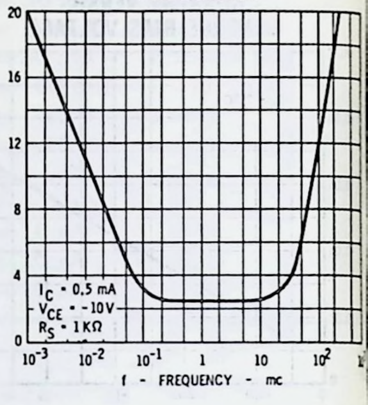


SCALE • 2 nsec/cm

NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT

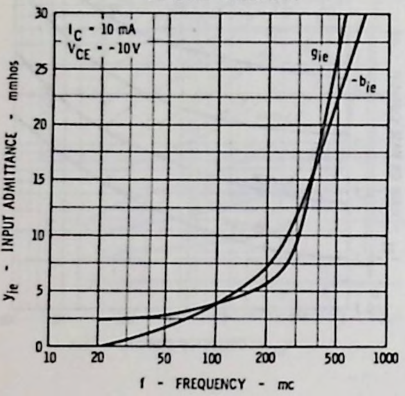


NOISE FIGURE VERSUS FREQUENCY

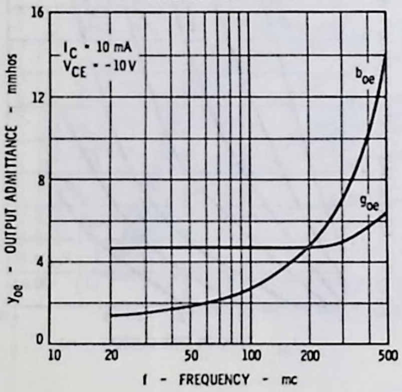


TYPICAL COMMON EMITTER "Y" PARAMETERS

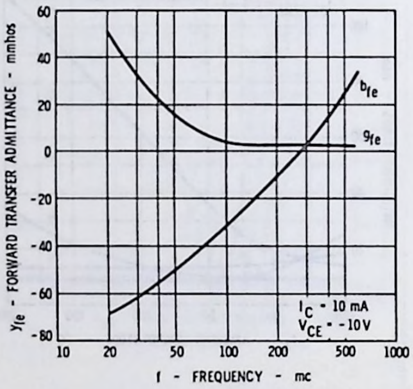
INPUT ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



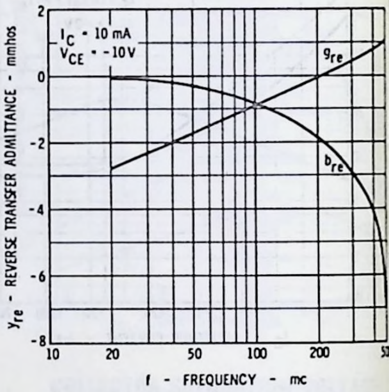
OUTPUT ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



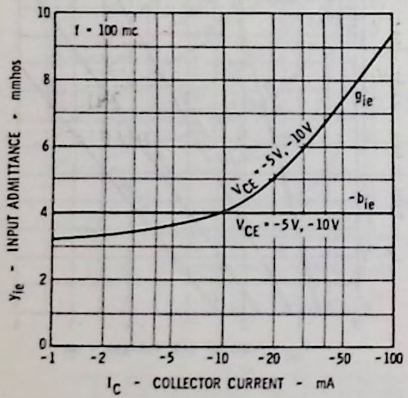
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



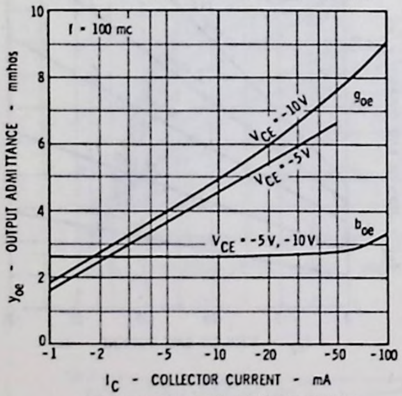
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



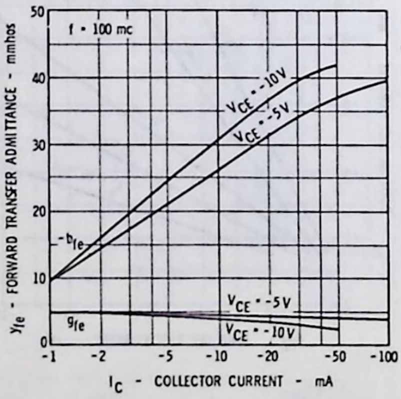
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



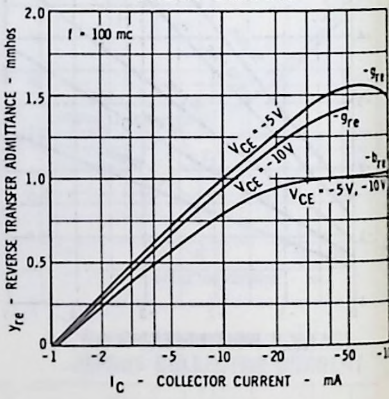
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



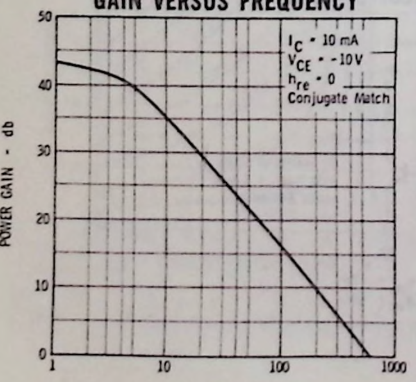
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



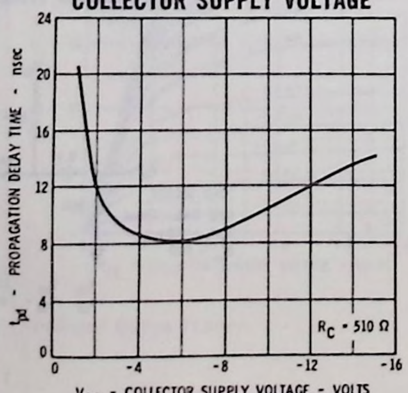
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



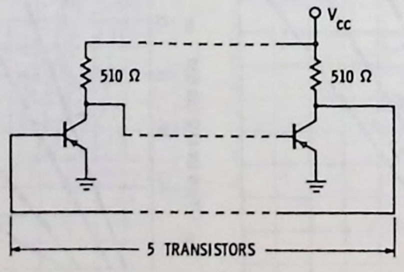
IDEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY



$$tpd = \frac{1}{10\, f_{osc}}$$

FM870 · 2N1889 · 2N870
FM871 · 2N1890 · 2N871

NPN HIGH VOLTAGE AMPLIFIER AND OSCILATOR TYPE

DIFFUSED SILICON PLANAR * TRANSISTORS

GENERAL DESCRIPTION — These transistors are designed for high voltage large signal amplifier and oscillator applications where PLANAR* reliability and performance are desired.
Low leakage (typically 50 nanoamperes at 100°C and 75 volts) together with nearly constant current gain over more than four decades substantially improves linearity in large signal high voltage applications such as servo motor drivers and some operational amplifiers. A typical gain bandwidth of 90 megahertz and low capacitance permit improved performance in high frequency circuits such as electrostatic deflection amplifiers for CRT's and high level video amplifiers.

ABSOLUTE MAXIMUM RATINGS [Note 1]

		FM870 FM871	2N1889 2N1890	2N870 2N871
Maximum Temperatures				
Storage Temperature		−65°C to +300°C All Units		
Operating Junction Temperature		200°C Maximum All Units		
Maximum Power Dissipation				
Total Dissipation at 25°C Case Temperature [Note 2 and 3]		4.0 Watts	3.0 Watts	1.8 Watts
at 100°C Case Temperature [Note 2 and 3]		2.3 Watts	1.7 Watts	1.0 Watt
at 25°C Ambient Temperature		0.375 Watt	0.8 Watt	0.5 Watt
Maximum Voltages				
V_{CBO}	Collector to Base Voltage	100 Volts	100 Volts	100 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\Omega$)[Note 4]	80 Volts	80 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	60 Volts	60 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts	7.0 Volts	7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		2N870•FM870 2N1889			2N871•FM871 2N1890					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	40	75	120	100	130	300		$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	35	80			135			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	20	40			65			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	20	50			95			$I_C = 0.1$ mA	$V_{CE} = 10$ V
V_{BE} (sat)	Base Saturation Voltage		0.8	0.9		0.8	0.9	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.6	1.2		0.35	1.2	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{BE} (sat)	Base Saturation Voltage		0.9	1.3		0.9	1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE} (sat)	Collector Saturation Voltage		2.5	5.0		1.3	5.0	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain f = 20 MHz	2.5	4.0		3.0	5.0			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{ob}	Output Capacitance		13	15		13	15	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{TE}	Emitter Transition Capacitance		60	85		60	85	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		0.4	10		0.4	10	nA	$I_E = 0$	$V_{CB} = 75$ V
I_{CBO} (150°C)	Collector Cutoff Current		1.0	15		1.0	15	μA	$I_E = 0$	$V_{CB} = 75$ V
BV_{CBO}	Collector to Base Breakdown Voltage	100			100			Volts	$I_C = 0$	$I_E = 0.1$ mA
V_{CER} (sust)	Collector to Emitter Sustaining Voltage [Note 4]	80			80			Volts	$I_C = 100$ mA (pulsed)	$R_{BE} \leq 10\,\Omega$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 4]	60			60			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			7.0			Volts	$I_C = 0$	$I_E = 0.1$ mA
I_{EBO}	Emitter Cutoff Current		0.1	10		0.1	10	nA	$I_C = 0$	$V_{EB} = 5.0$ V

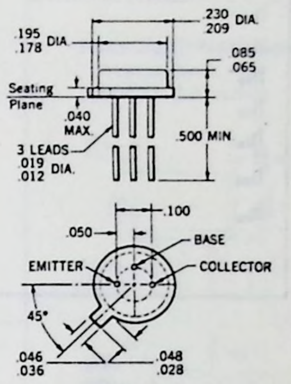
* Planar is a patented Fairchild process.

NOTES:

1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations. See thermal network on page 4 for typical pulse ratings.
3) These ratings give a maximum junction temperature of 200°C and thermal resistance (junction-to-case) for the FM870 and FM871 of 43.7°C/watt (derating factor of 22.9 mW/°C); for the 2N1889 and 2N1890 58.3°C/watt (derating factor of 17.2 mW/°C) and for the 2N870 and 2N871 97.1°C/watt (derating factor of 10.3 mW/°C).
4) These ratings refer to a high current point where collector-to-emitter voltage is lowest.
5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-46) outline

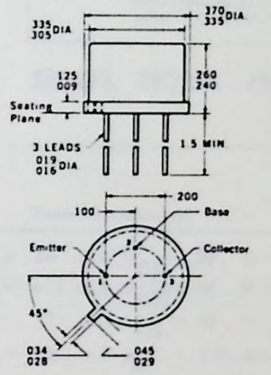


NOTES: All dimensions in inches
Leads are gold plated Kovar
Lead No. 3 internally connected to case
Package weight is 0.34 gram

FM870 • FM871

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-5) outline

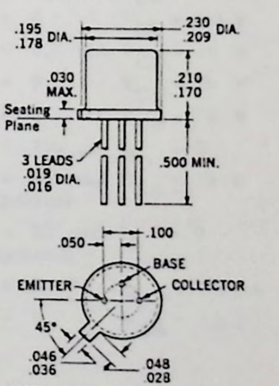


NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 1.1 grams

2N1889 • 2N1890

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar*
Lead No. 3 internally connected to case
Package weight is 0.44 gram

2N870 • 2N871

FAIRCHILD
SEMICONDUCTOR
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SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

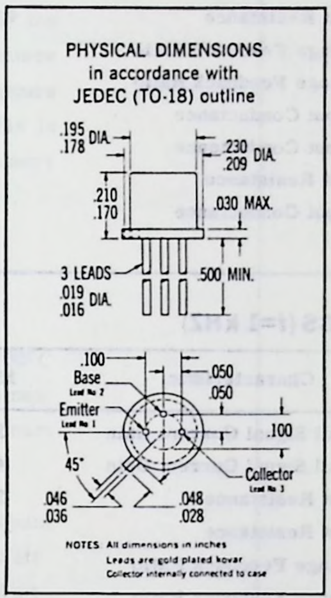
SYMBOL	CHARACTERISTIC	FM870•2N1889 2N870			FM871•2N1890 2N871			UNITS	TEST CONDITIONS	
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
h_{ib}	Input Resistance	20	26.9	30	20	27.5	30	ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ib}	Input Resistance	4.0	6.1	8.0	4.0	6.4	8.0	ohms	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{ob}	Output Conductance		0.12	0.5		0.15	0.3	μmho	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance		0.14	0.5		0.16	0.3	μmho	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio		0.52	1.25		0.92	1.50	$x10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{rb}	Voltage Feedback Ratio		0.59	1.50		0.84	1.50	$x10^{-4}$	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain	30	72	100	50	125	200		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain	45	80	150	70	149	300		$I_C = 5.0$ mA	$V_{CE} = 10$ V
h_{ie}	Input Resistance		2.3			3.5		kohms	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance		9.0			16.5		μmho	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio		3.0			4.6		$x10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

2N910 • 2N911 • 2N912 • 2N1973 • 2N1974 • 2N1975

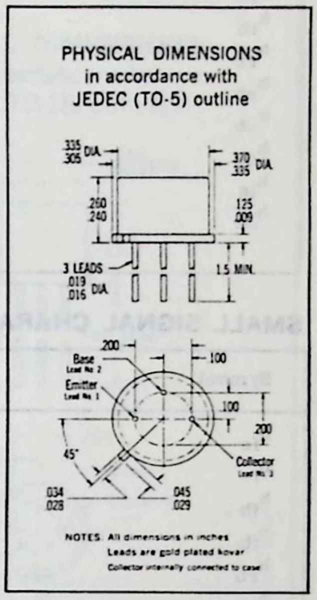
NPN SMALL SIGNAL

DIFFUSED SILICON PLANAR* TRANSISTORS

GENERAL DESCRIPTION - These NPN Double-Diffused Silicon Planar Transistors are designed for small-signal type applications. They replace grown junction and mesa types such as the 2N333 through 2N336 and 2N1564 through 2N1566. Their improved performance is reflected in lower noise... tighter parameter limits... lower leakage... and improved characteristic stability with age. The "h" parameters are specified at two operating levels. The three small-signal beta ranges, 76 to 200, 36 to 90 and 18 to 50; cover most small-signal applications. BV_{CBO} of 100 volts and f_T of 80 MHz offer a wide range of applications in Class-A amplifiers.


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline
.195 DIA.
.178
.230 DIA.
.209
.210
.170
.030 MAX.
3 LEADS
.019 DIA.
.016
.500 MIN.
.100
Base
Lead No. 2
.050
.050
Emitter
Lead No. 1
.100
45°
Collector
Lead No. 3
.046
.036
.048
.028
NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N910 2N911 2N912


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline
.335 DIA.
.305
.370 DIA.
.335
.260
.240
.125
.009
3 LEADS
.019 DIA.
.016
1.5 MIN.
.200
.100
Base
Lead No. 2
Emitter
Lead No. 1
.100
.200
45°
Collector
Lead No. 3
.034
.028
.045
.029
NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N1973 2N1974 2N1975

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

		2N910 2N911 2N912	2N1973 2N1974 2N1975
Maximum Temperatures			
Storage Temperature		-65°C to +300°C	-65°C to +300°C
Operating Junction Temperature		+200°C Maximum	+200°C Maximum
Maximum Power Dissipation (Notes 2 & 3)			
Total Dissipation at 25°C Case Temperature		1.8 Watts	3.0 Watts
at 100°C Case Temperature		1.0 Watt	1.7 Watts
at 25°C Ambient Temperature		0.5 Watt	0.8 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	100 Volts	100 Volts
V_{CER}	Collector to Emitter Sustaining Voltage	80 Volts	80 Volts
V_{CEO}	Collector to Emitter Sustaining Voltage	60 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts	7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N910 2N1973			2N911 2N1974			2N912 2N1975				
Symbol	Characteristics	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	75	135		35	70		15	42			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	35	100		20	45		10	33			I_C = 0.1 mA V_{CE} = 10 V
h_{FE}(150°C)	DC Pulse Current Gain (Note 5)	30	50		15	30		10	15			I_C = 10 mA V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage	0.6	0.65	0.8	0.6	0.65	0.8	0.6	0.65	0.8	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.13	0.4		0.13	0.4		0.16	0.4	Volts	I_C = 10 mA I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage		0.72	0.9		0.73	0.9		0.7	0.9	Volts	I_C = 50 mA I_B = 5.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.22	1.2		0.22	1.2		0.24	1.2	Volts	I_C = 50 mA I_B = 5.0 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0	4.0		2.5	3.5		2.0	3.0			I_C = 50 mA V_{CE} = 10 V
C_{obo}	Output Capacitance			15			15			15	pF	I_E = 0 V_{CB} = 10 V
C_{ibo}	Input Capacitance			85			85			85	pF	I_C = 0 V_{EB} = 0.5 V
NF	Noise Figure (Note 6)			12			15			18	dB	I_C = 0.3 mA V_{CE} = 10 V
I_{CBO}	Collector Cutoff Current			25			25			25	mμA	I_E = 0 V_{CB} = 75 V
I_{CBO}(150°C)	Collector Cutoff Current			15			15			15	μA	I_E = 0 V_{CB} = 75 V
BV_{CBO}	Collector to Base Breakdown Voltage	100			100			100			Volts	I_C = 100 μA I_E = 0
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	80			80			80			Volts	I_C = 100 mA (pulsed) $R_{BE} \leq 10\ \Omega$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60			60			60			Volts	I_C = 30 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			7.0			7.0			Volts	I_C = 0 I_E = 100 μA
I_{EBO}	Emitter Current			25			25			25	mμA	I_C = 0 V_{EB} = 5.0 V

* Planar is a patented Fairchild process.

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FAIRCHILD
SEMICONDUCTOR
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SMALL SIGNAL CHARACTERISTICS (f=1 kHZ)

Symbol	Characteristics	Min.	Typ.	Max.	Units	Test Conditions
h_{fe}	Small Signal Current Gain	76	125	200		I_C = 1.0 mA V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain	80	140	200		I_C = 5.0 mA V_{CE} = 5.0 V
h_{ib}	Input Resistance	20	26	30	Ohms	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ib}	Input Resistance	4.0	6.0	8.0	Ohms	I_C = 5.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		0.75	3.0	$x10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		0.95	4.0	$x10^{-4}$	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		0.13	0.5	µmho	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		0.2	1.0	µmho	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ie}	Input Resistance		1000	1800	Ohms	I_C = 5.0 mA V_{CE} = 5.0 V
h_{oe}	Output Conductance		20	100	µmho	I_C = 5.0 mA V_{CE} = 5.0 V

SMALL SIGNAL CHARACTERISTICS (f=1 kHZ)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{fe}	Small Signal Current Gain	36	65	90		I_C = 1.0 mA V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain	40	70	100		I_C = 5.0 mA V_{CE} = 5.0 V
h_{ib}	Input Resistance	20	25	30	Ohms	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ib}	Input Resistance	4.0	6.0	8.0	Ohms	I_C = 5.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		0.45	1.25	$x10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		0.7	1.75	$x10^{-4}$	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		0.13	0.5	µmho	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		0.15	1.0	µmho	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ie}	Input Resistance		600	1000	Ohms	I_C = 5.0 mA V_{CE} = 5.0 V
h_{oe}	Output Conductance		10	50	µmho	I_C = 5.0 mA V_{CE} = 5.0 V

SMALL SIGNAL CHARACTERISTICS (f=1 kHZ)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{fe}	Small Signal Current Gain	18	38	50		I_C = 1.0 mA V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain	20	45	50		I_C = 5.0 mA V_{CE} = 5.0 V
h_{ib}	Input Resistance	20	26	30	Ohms	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ib}	Input Resistance	4.0	6.0	8.0	Ohms	I_C = 5.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		0.3	1.25	$x10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		0.5	1.75	$x10^{-4}$	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		0.13	0.5	µmho	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		0.2	1.0	µmho	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ie}	Input Resistance		350	600	Ohms	I_C = 5.0 mA V_{CE} = 5.0 V
h_{oe}	Output Conductance		8.0	25	µmho	I_C = 5.0 mA V_{CE} = 5.0 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C) for the 2N1973, 2N1974, and 2N1975; for the 2N910, 2N911, and 2N912 97.3°C/Watt (derating factor of 10.3 mW/°C). Junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the 2N1973, 2N1974, and 2N1975; for the 2N910, 2N911, and 2N912 350°C/Watt (derating factor of 2.86 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 µsec; duty cycle ≤ 2%.

(6) Frequency = 1000 Hz, 200 Hz bandwidth, R_g = 510 Ω.

2N914

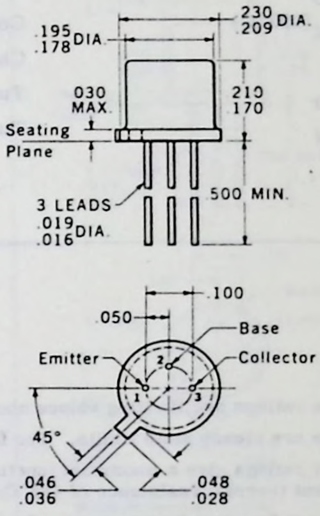
NPN SATURATED LOGIC SWITCH AND VHF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The 2N914 is an NPN Double-Diffused Silicon Planar Epitaxial Transistor encased in the JEDEC TO-18 package. It provides improved operation over the popular 2N706 and 2N708, and also gives greater latitude in circuit design. The Planar structure provides low leakage currents, wide beta range, and superior reliability. The epitaxial feature gives an extremely low V_{CE}(sat) that is relatively temperature insensitive. The 2N914 is primarily a universal switch but it is also an excellent high-speed high-gain logic and memory driver at collector currents up to 500 milliamperes.

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.44 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Solder, No Time Limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.2 Watts
at 100°C Case Temperature	(Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.36 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		40 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\,\Omega$)	(Note 4)	20 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage		5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics		Min.	Typ.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain	(Note 5)	30	55	120		I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}(-55°C)	DC Pulse Current Gain	(Note 5)	12	28			I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain	(Note 5)	10	17			I_C = 500 mA	V_{CE} = 5.0 V
V_{BE}(sat)	Base Saturation Voltage		0.70	0.74	0.80	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage			0.40	0.70	Volts	I_C = 200 mA	I_B = 20 mA
V_{CE}(sat)	Collector Saturation Voltage (-55°C to +125°C)	(Note 6)		0.20	0.25	Volts	I_C = 10 I_B	
h_{fe}	High Frequency Current Gain (f = 100 Mc)		3.0	3.7			I_C = 20 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance			4.5	6.0	pf	I_E = 0	V_{CB} = 10 V
C_{ibo}	Input Capacitance				9.0	pf	I_C = 0	V_{EB} = 0.5 V

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics	Min.	Typ.	Max.	Units	Test Conditions
I_{CBO}	Collector Cutoff Current		4.0	25	mμA	$I_E = 0$ $V_{CB} = 20$ V
I_{CBO}(150°C)	Collector Cutoff Current		3.0	15	μA	$I_E = 0$ $V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	$I_C = 1.0$ μA $I_E = 0$
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	20			Volts	$I_C = 30$ mA (pulsed) $R_{BE} \leq 10$ Ω
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			Volts	$I_C = 30$ mA (pulsed) $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_C = 0$ $I_E = 10$ μA
I_{EBO}	Emitter Current		0.007	0.1	μA	$I_C = 0$ $V_{EB} = 4.0$ V
I_{CEX}(125°C)	Collector Current		3.0	10	μA	$V_{CE} = 20$ V $V_{BE} = +0.25$ V
τ_s	Charge Storage Time Constant (Notes 7 and 8)		13	20	nsec	$I_C = I_{B1} \approx 20$ mA, $I_{B2} \approx -20$ mA
t_{d+r}	Turn On Time (Note 8)		25	40	nsec	$I_C \approx 200$ mA, $I_{B1} \approx 40$ mA
t_{s+f}	Turn Off Time (Note 8)		25	40	nsec	$I_C \approx 200$ mA, $I_{B1} \approx 40$ mA, $I_{B2} \approx -20$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 145°C/Watt (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.1 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

(5) Pulse conditions: Length = 300 μsec; duty cycle = 1%.

(6) I_C = 1.0 mA through 20 mA.

(7) Measured on Sampling Scope. PW ≥ 200 nsec.

(8) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

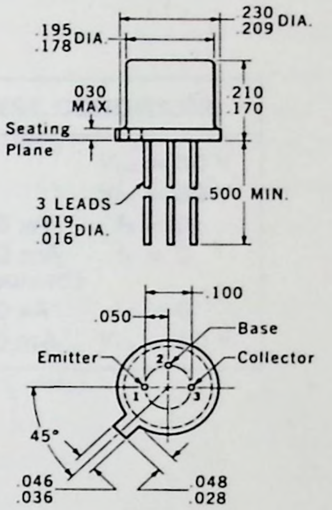
2N915 · 2N916

NPN HIGH FREQUENCY AMPLIFIER AND OSCILLATOR TYPE

DIFFUSED SILICON PLANAR TRANSISTORS

The **2N915** and **2N916** are NPN double-diffused silicon PLANAR transistors. These units are designed for low-power non-saturating switching circuits and low-noise VHF amplifier and oscillator applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.44 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	**−65°C to +300°C**
Operating Junction Temperature	**200°C** Maximum
Lead Temperature (Soldering, No Time Limit)	**300°C** Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	**1.2** Watts
at 100°C Case Temperature [Notes 2 and 3]	**0.68** Watt
at 25°C Ambient Temperature [Notes 2 and 3]	**0.36** Watt

Maximum Voltages		**2N915**	**2N916**
V_{CBO}	Collector to Base Voltage	**70** Volts	**45** Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	**50** Volts	**25** Volts
V_{EBO}	Emitter to Base Voltage	**5.0** Volts	**5.0** Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N915 Min.	2N915 Typ.	2N915 Max.	2N916 Min.	2N916 Typ.	2N916 Max.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	**50**	**110**	**200**					$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]				**50**	**100**	**200**		$I_C = 10$ mA	$V_{CE} = 1.0$ V
V_{BE} (sat)	Base Saturation Voltage		**0.77**	**0.9**		**0.78**	**0.9**	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		**0.45**	**1.0**		**0.25**	**0.5**	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	**2.5**	**3.6**		**3.0**	**4.0**			$I_C = 10$ mA	$V_{CE} = 15$ V
C_{ob}	Output Capacitance		**3.0**	**3.5**				pf	$I_E = 0$	$V_{CB} = 10$
C_{ob}	Output Capacitance					**4.2**	**6.0**	pf	$I_E = 0$	$V_{CB} = 5.0$ V
C_{TE}	Emitter Transition Capacitance		**6.5**	**10**		**6.5**	**10**	pf	$I_C = 0$	$V_{EB} = 0.5$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 145°C/Watt (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse conditions: length = 300 μsec; duty cycle = 1%.

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	Min.	Typ.	Max.	UNITS	TEST CONDITIONS	
I_{CBO}	Collector Cutoff Current		0.8	10	nA	$I_E = 0$	$V_{CB} = 60$ V
I_{CBO} (150°C)	Collector Cutoff Current		0.5	30	μA	$I_E = 0$	$V_{CB} = 60$ V
BV_{CBO}	Collector to Base Breakdown Voltage	70			Volts	$I_E = 0$	$I_C = 100$ μA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	50			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_E = 10$ μA	$I_C = 0$
$r_b'C_c$	Collector Base Time Constant (f = 40 mc)		170	300	psec	$I_C = 10$ mA	$V_{CB} = 10$ V

SMALL SIGNAL CHARACTERISTICS (f = 1 kc)

SYMBOL	CHARACTERISTIC	2N915 Min.	2N915 Typ.	2N915 Max.	2N916 Min.	2N916 Typ.	2N916 Max.	UNITS	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain	40	115	200	40	100	200		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
		50	140	250	50	120	250		$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
h_{ie}	Input Resistance		3.0	6.0		2.6	6.0	Kohms	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
			0.7	2.0		0.6	2.0	Kohms	$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance		12	75		6.0	75	μmho	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
			45	125		35	125	μmho	$I_C = 5.0$ mA	$V_{CE} = 5.0$ V

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	Min.	Typ.	Max.	UNITS	TEST CONDITIONS	
I_{CBO}	Collector Cutoff Current		0.1	10	nA	$I_E = 0$	$V_{CB} = 30$ V
I_{CBO} (150°C)	Collector Cutoff Current		0.2	10	μA	$I_E = 0$	$V_{CB} = 30$ V
BV_{CBO}	Collector to Base Breakdown Voltage	45			Volts	$I_C = 10$ μA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	25			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_E = 10$ μA	$I_C = 0$
$r_b'C_c$	Collector-Base Time Constant (f = 40 mc)		200	300	psec	$I_C = 10$ mA	$V_{CB} = 10$ V

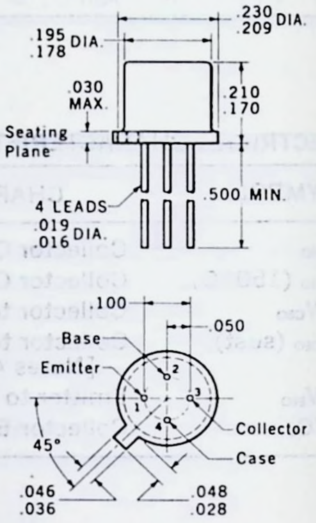
2N918

NPN ULTRA-HIGH FREQUENCY OSCILLATOR AND AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

The 2N918 is an NPN double-diffused silicon PLANAR Epitaxial Transistor. It is designed for low-noise high-frequency amplifiers; 1 GHz local oscillators; non-neutralized i-f amplifiers and non-saturating circuits with rise and fall times of less than 2.5 nanoseconds.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold plated kovar

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, No Time Limit)	+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.3 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Current Gain	20	50			I_C = 3.0 mA V_{CE} = 1.0 V
$V_{BE}(sat)$	Base Saturation Voltage			1.0	Volts	I_C = 10 mA I_B = 1.0 mA
$V_{CE}(sat)$	Collector Saturation Voltage			0.4	Volts	I_C = 10 mA I_B = 1.0 mA
C_{obo}	Common-Base, Open-Circuit Output Capacitance		1.0	1.7	pF	I_E = 0 V_{CB} = 10 V
C_{obo}	Common-Base, Open-Circuit Output Capacitance		1.8	3.0	pF	I_E = 0 V_{CB} = 0
C_{ibo}	Input Capacitance			2.0	pF	I_C = 0 V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current			10	nA	I_E = 0 V_{CB} = 15 V
$I_{CBO}(150°C)$	Collector Cutoff Current			1.0	μA	I_E = 0 V_{CB} = 15 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	6.0	9.0			I_C = 4.0 mA V_{CE} = 10 V
G_{pe}	Available Power Gain (nuetralized) (f = 200 MHz)	15	18		dB	I_C = 6.0 mA V_{CB} = 12 V
P_o	Power Output (f = 500 MHz)	30	40		mW	I_C = 8.0 mA V_{CB} = 15 V
η	Collector Efficiency (f = 500 MHz)	25			%	I_C = 8.0 mA V_{CB} = 15 V
NF	Noise Figure (Note 5)		3.0	6.0	dB	I_C = 1.0 mA V_{CE} = 6.0 V f = 60 MHz , Rg = 400 Ω
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Note 4)	15			Volts	I_C = 3.0 mA I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	I_C = 1.0 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_C = 0 I_E = 10 μA

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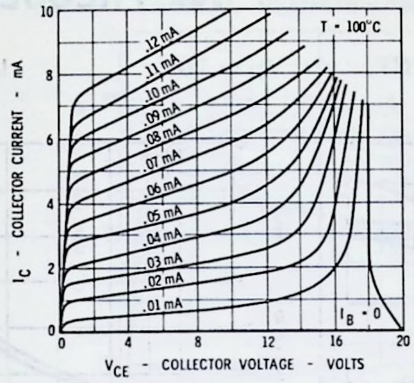
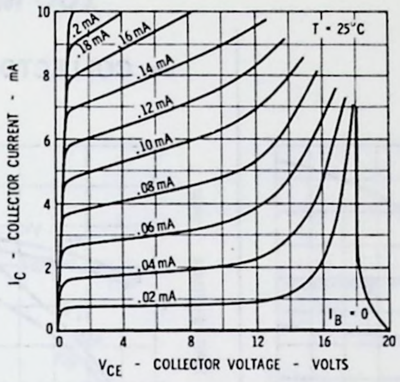
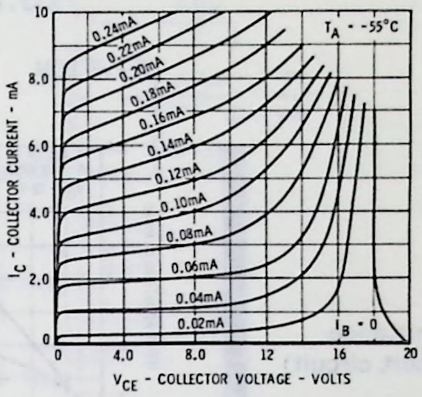
* Planar is a patented Fairchild process

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

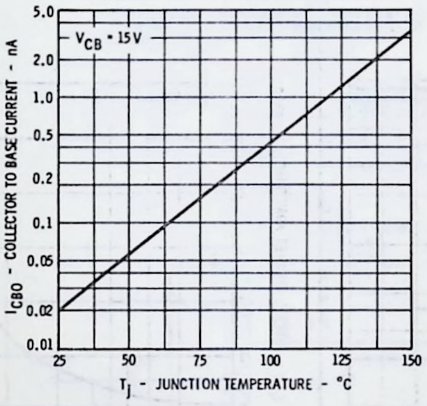
TYPICAL COLLECTOR CHARACTERISTICS*



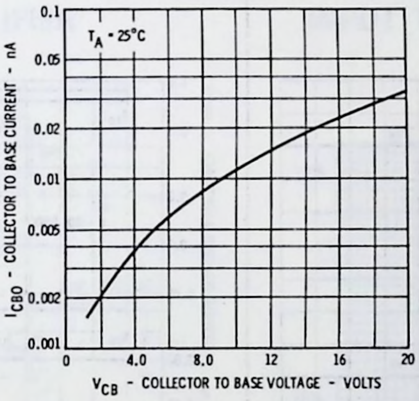




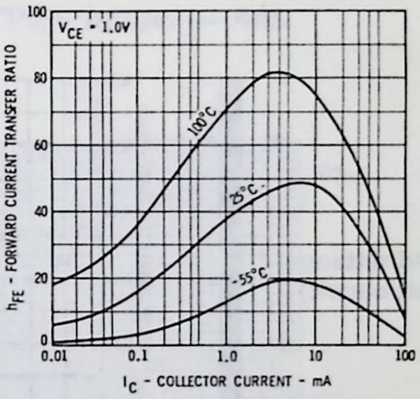
TYPICAL ELECTRICAL CHARACTERISTICS



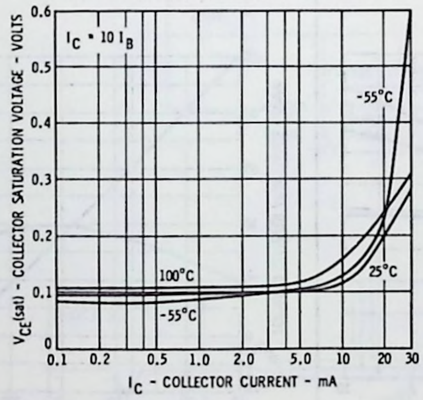
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



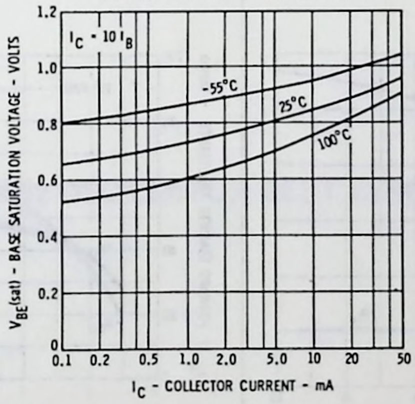
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



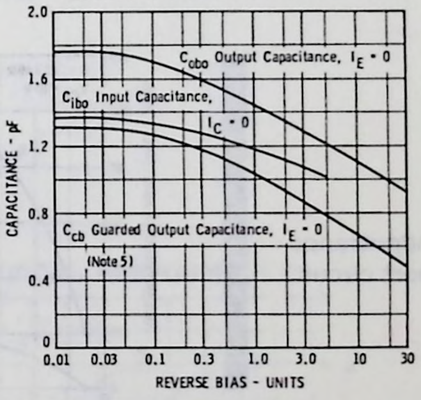
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



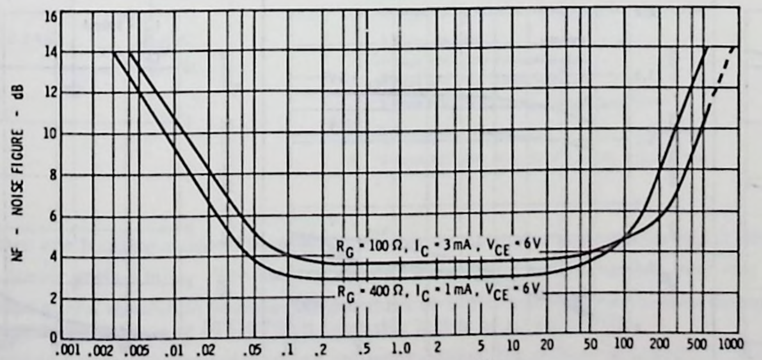
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



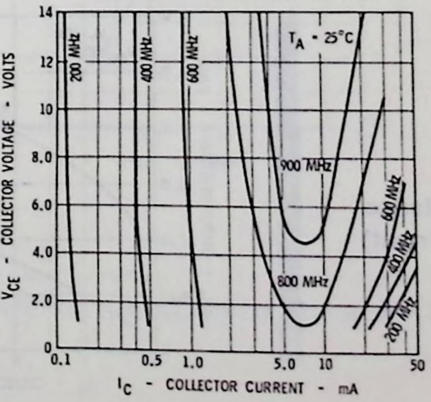
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



NOISE FIGURE VERSUS FREQUENCY



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

** Single family characteristics on Transistor Curve Tracer.

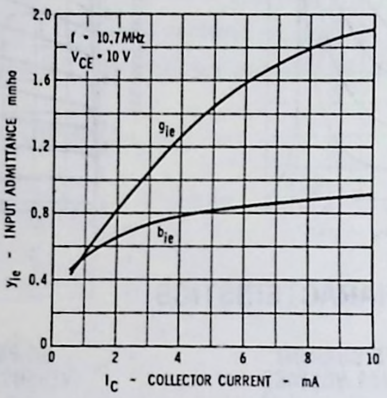
TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

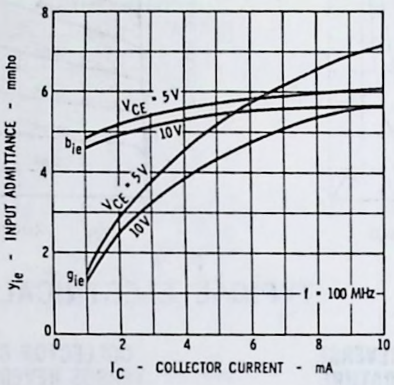
10.7 MHz 100 MHz vs. FREQUENCY

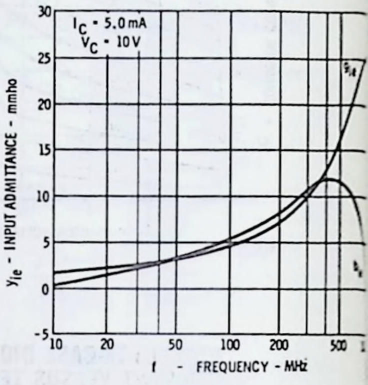
$V_{CE} = 10V$ vs. COLLECTOR CURRENT $V_{CE} = 10V$ $I_C = 5$ m

y_{ie}

Input Admittance (output short circuit)

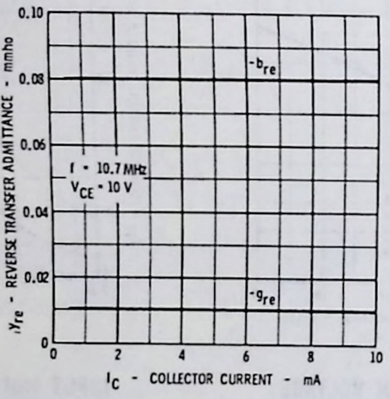


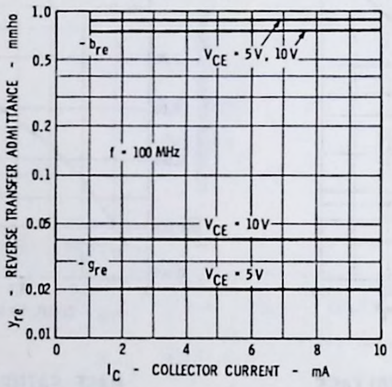


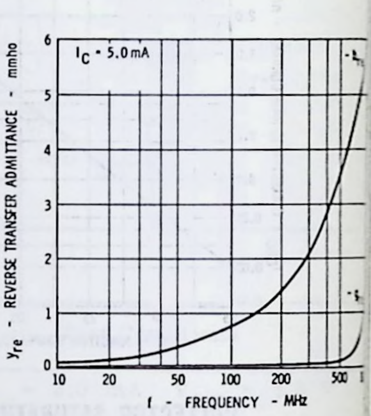


y_{re}

Reverse Transfer Admittance (input short circuit)

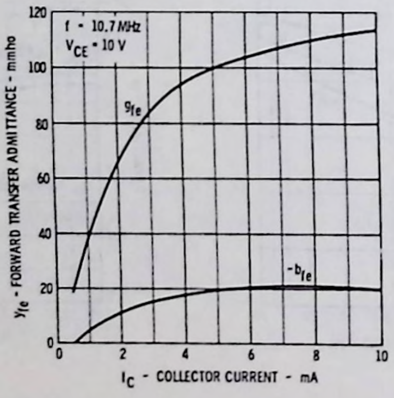


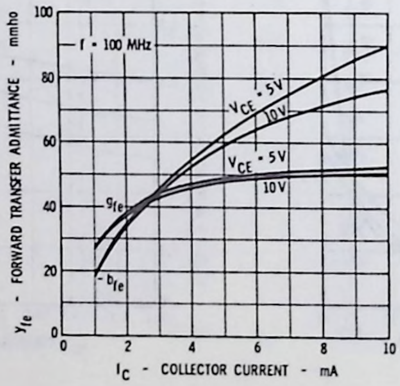


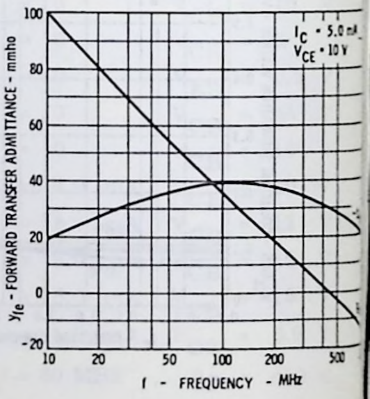


y_{fe}

Forward Transfer Admittance (output short circuit)

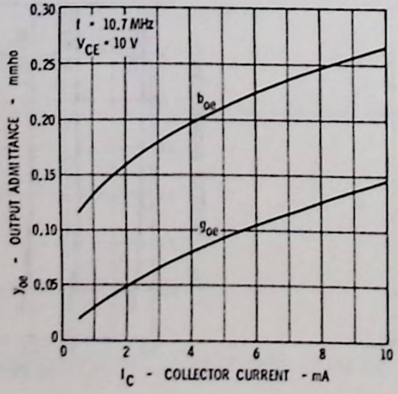


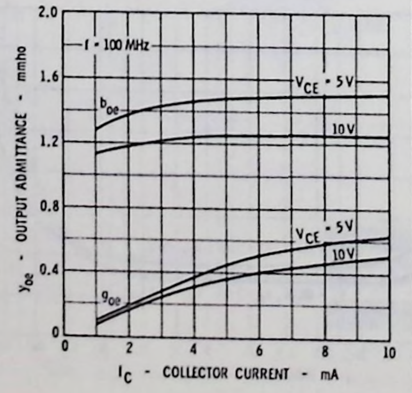


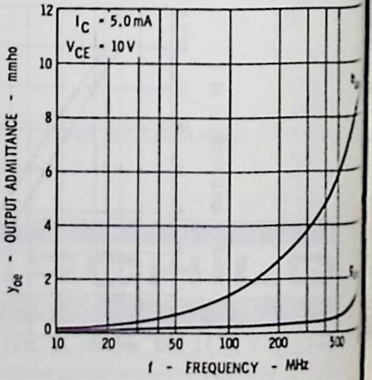


y_{oe}

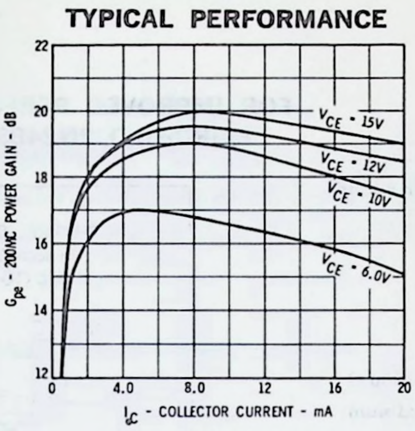
Output Admittance (input short circuit)



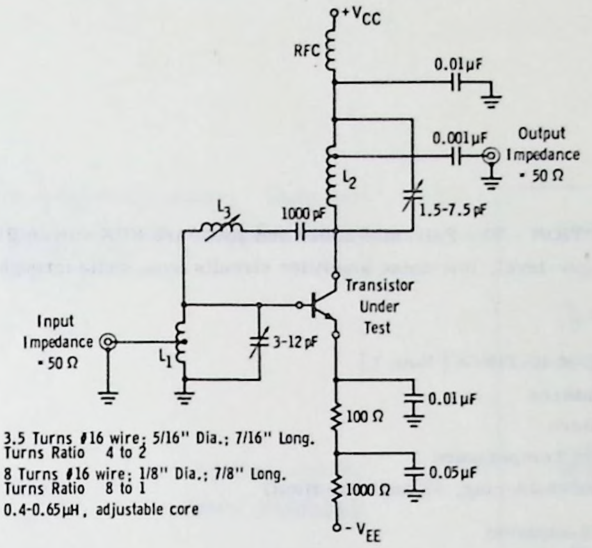




NEUTRALIZED 200 MHz POWER GAIN AMPLIFIER TEST CIRCUIT



TYPICAL PERFORMANCE



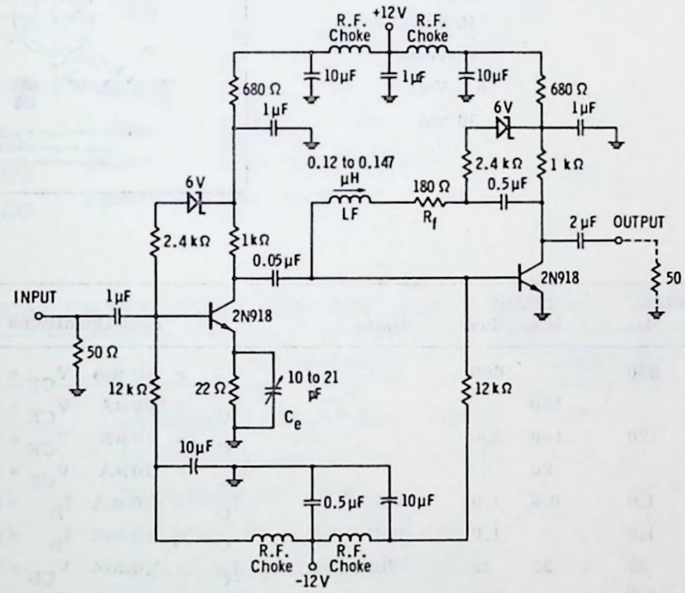
$+V_{CC}$
RFC
0.01µF
0.001µF
Output Impedance = 50 Ω
L_2
1.5-7.5 pF
1000 pF
L_3
Transistor Under Test
Input Impedance = 50 Ω
L_1
3-12 pF
100 Ω
0.01µF
0.05µF
1000 Ω
$-V_{EE}$

L_1 - 3.5 Turns #16 wire; 5/16" Dia.; 7/16" Long. Turns Ratio 4 to 2

L_2 - 8 Turns #16 wire; 1/8" Dia.; 7/8" Long. Turns Ratio 8 to 1

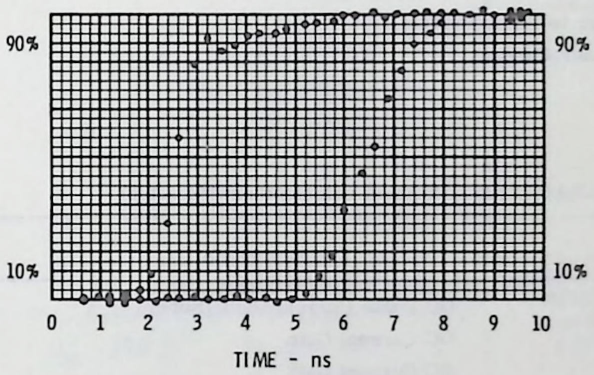
L_3 - 0.4-0.65µH, adjustable core

TWO STAGE VIDEO AMPLIFIER

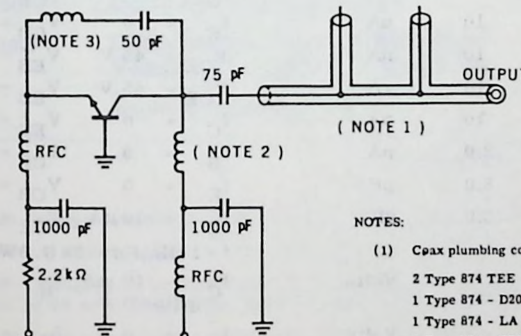


R.F. Choke
+12V
R.F. Choke
680 Ω
10µF
1µF
10µF
680 Ω
1µF
6V
1µF
0.12 to 0.147 µH
LF
180 Ω
R_f
2.4 kΩ
1 kΩ
0.5µF
6V
2.4 kΩ
1kΩ
0.05µF
2µF
OUTPUT
50 Ω
2N918
INPUT
1µF
50 Ω
2N918
12 kΩ
22 Ω
10 to 21 pF
C_e
12 kΩ
10µF
0.5µF
10µF
R.F. Choke
-12V
R.F. Choke

INPUT TO OUTPUT DELAY — 4ns



500 MHz OSCILLATOR TEST CIRCUIT



(NOTE 3)
50 pF
75 pF
OUTPUT
(NOTE 1)
RFC
(NOTE 2)
1000 pF
1000 pF
2.2 kΩ
RFC
V_{EE}
V_{CC}

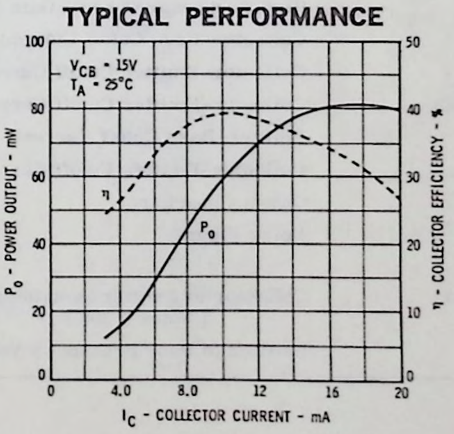
NOTES:

(1) Coax plumbing consists of the following GR air lines:

2 Type 874 TEE
1 Type 874 - D20 Adjustable Stub
1 Type 874 - LA Adjustable Line
1 Type 874 - WN3 Short - Circuit Termination

(2) 2 turns #16 AWG wire, 3/8 inch OD, 1-1/4 inch long

(3) 9 turns #22 AWG wire, 3/16 inch OD, 1/2 inch long



TYPICAL PERFORMANCE

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 584°C/Watt (derating factor of 1.71 mW/°C). Junction-to-ambient thermal resistance of 875°C/Watt (derating factor of 1.14 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) C_{cb} is measured using three terminal measurement technique with case and emitter guarded.

2N929 · 2N930

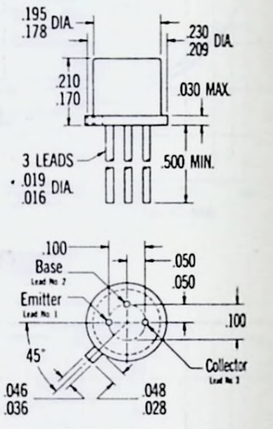
NPN LOW LEVEL, LOW LNOISE AMPLIFIER

SILICON PLANAR* TRANSISTORS

FOR IMPROVED PERFORMANCE S
FAIRCHILD 2N2483 AND 2N24

GENERAL DESCRIPTION - The Fairchild 2N929 and 2N930 are NPN silicon PLANAR transistors designed for use in high-performance, low-level, low-noise amplifier circuits from audio through high frequency ranges.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	-65° C to +300° C
Operating Junction Temperature	175° C Maximum
Lead Temperature (Soldering, 10 sec time limit)	230° C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.6 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.3 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	45 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	45 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts
I_C Collector Current	30 mA

ELECTRICAL CHARACTERISTICS (25° C unless otherwise noted)

Symbol	Characteristic	2N929 Min.	2N929 Max.	2N930 Min.	2N930 Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain [Note 5]		350		600		I_C = 10 mA V_{CE} = 5.0 V
h_{FE}	DC Current Gain	60		150			I_C = 500 μA V_{CE} = 5.0 V
h_{FE}	DC Current Gain	40	120	100	300		I_C = 10 μA V_{CE} = 5.0 V
h_{FE} (-55°C)	DC Current Gain	10		20			I_C = 10 μA V_{CE} = 5.0 V
V_{BE}	Base-Emitter Voltage [Note 5]	0.6	1.0	0.6	1.0	Volt	I_C = 10 mA I_B = 0.5 mA
V_{CE}(sat)	Collector Saturation Voltage [Note 5]		1.0		1.0	Volt	I_C = 10 mA I_B = 0.5 mA
h_{ib}	Input Resistance (f = 1 kHz)	25	32	25	32	Ohms	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance (f = 1 kHz)		1.0		1.0	μmho	I_C = 1.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio (f = 1 kHz)		600		600	$\times 10^{-6}$	I_C = 1.0 mA V_{CB} = 5.0 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	60	350	150	600		I_C = 1.0 mA V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 30 MHz)	1.0		1.0			I_C = 500 μA V_{CE} = 5.0 V
I_{CBO}	Collector-Base Cutoff Current		10		10	nA	I_E = 0 V_{CB} = 45 V
I_{CES}	Collector-Emitter Cutoff Current		10		10	nA	V_{CE} = 45 V V_{EB} = 0
I_{CES} (170°C)	Collector-Emitter Cutoff Current		10		10	μA	V_{CE} = 45 V V_{EB} = 0
I_{EBO}	Emitter-Base Cutoff Current		10		10	nA	I_C = 0 V_{EB} = 5.0 V
I_{CEO}	Collector-Emitter Cutoff Current		2.0		2.0	nA	I_B = 0 V_{CE} = 5.0 V
C_{obo}	Output Capacitance		8.0		8.0	pF	I_E = 0 V_{CB} = 5.0 V
NF	Noise Figure		4.0		3.0	dB	I_C = 10 μA V_{CE} = 5.0 V f = 1 kHz, Rs = 10 k Ω, BW = 200 Hz
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	45		45		Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		Volts	I_C = 0 I_E = 10 nA

* Planar is a patented Fairchild pro

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 250°C/watt (derating factor of 4.0 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse conditions: length ≤ 300 μsec; duty cycle ≤ 2%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATIO

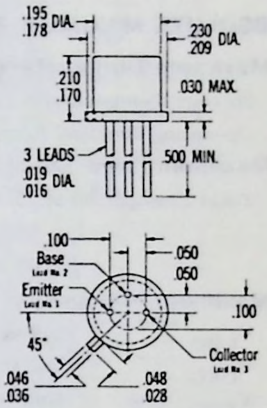
2N978 • 2N1991

PNP GENERAL-PURPOSE TYPE

DIFFUSED SILICON TRANSISTORS

GENERAL DESCRIPTION - The 2N978 and 2N1991 are double diffused silicon PNP transistors. They are designed for industrial high-speed switching and amplifier applications and can be used in complementary type circuitry with the Fairchild 2N1985 and 2N1987. Typical f_T is 50 mc.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N978

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures		
Storage Temperature		-65°C to +150°C
Operating Junction Temperature		+150°C Maximum
Maximum Power Dissipation	2N978	2N1991
Total Dissipation at 25°C Case Temperature [Note 2 & 3]	1.25	2.0 Watts
at 100°C Case Temperature [Note 2 & 3]	0.50	1.0 Watt
at 25°C Ambient Temperature	0.33	0.6 Watt
Maximum Voltages		
V_{CBO} - Collector to Base Voltage		-30 Volts
V_{CEO} - Collector to Emitter Voltage		-20 Volts
V_{EBO} - Emitter to Base Voltage		-5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristics	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain [Note 5]	15	60		I_C = 150 mA	V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain [Note 5]	15			I_C = 30 mA	V_{CE} = -10 V
V_{BE}(sat)	Base Saturation Voltage		-1.5	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage		-1.5	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain f = 20 mc	2.0			I_C = 50 mA	V_{CE} = -10 V
C_{ob}	Output Capacitance		45	pf	I_E = 0	V_{CB} = -10 V
I_{CBO}	Collector Cutoff Current		5.0	µA	I_E = 0	V_{CB} = -10 V
I_{CBO}(+150°C)	Collector Cutoff Current		200	µA	I_E = 0	V_{CB} = -10 V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Pulsed) [Note 4]	-20		Volts	I_C = 100 mA	I_B = 0
I_{EBO}	Emitter Current		200	µA	I_C = 0	V_{EB} = -1.0 V

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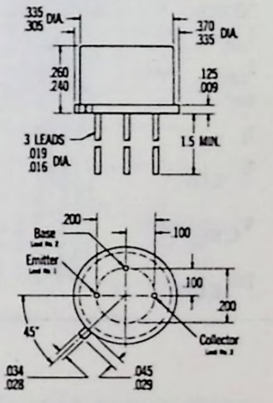
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N1991

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 150°C and junction-to-case thermal resistance of 62.5°C/watt (derating factor of 16 mW/°C) for the 2N1991; and for the 2N978, 100°C/watt (derating factor of 10 mW/°C).
4. Rating refers to a high current point where collector-to-emitter voltage is lowest.
5. Pulse conditions: length = 300 µsec; duty cycle = 1%.

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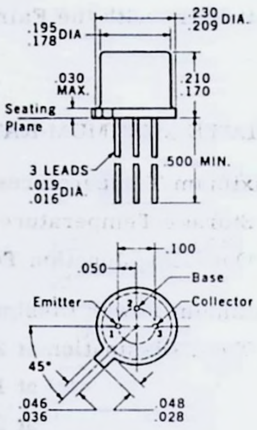
2N995

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The 2N995 is a double diffused silicon PNP planar epitaxial transistor packaged in the JEDEC TO-18 outline. It is designed as a high-frequency, low noise, general-purpose transistor which will replace germanium units in many applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
Storage Temperature			-65°C to +200°C
Operating Junction Temperature			200°C Maximum
Maximum Power Dissipation			
Total Dissipation at 25°C Case Temperature		(Notes 2 & 3)	1.2 Watts
at 100°C Case Temperature		(Notes 2 & 3)	0.68 Watt
at 25°C Ambient Temperature			0.36 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage		-20 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-15 Volts
V_{EBO}	Emitter to Base Voltage		-4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Unless Otherwise Noted)

Symbol	Characteristic	Min.	Type.	Max.	Units	Test Conditions
h_{FE}	DC Current Gain (Note 5)	35		140		I_C = 20 mA V_{CE} = -1.0 V
V_{BE}(sat)	Base Saturation Voltage			-0.95	Volts	I_C = 20 mA I_B = 2.0 mA
V_{CE}(sat)	Collector Saturation Voltage			-0.2	Volts	I_C = 20 mA I_B = 2.0 mA
f_T	Gain Bandwidth Product	100			Mc	I_C = 10 mA V_{CE} = -10 V
C_{obo}	Output Capacitance			10	pf	I_E = 0 V_{CB} = -10 V
C_{ibo}	Input Capacitance			11	pf	I_C = 0 V_{EB} = -0.5 V
*I_{CBO}	Collector Cutoff Current			5.0	nA	I_E = 0 V_{CB} = -15 V
I_{CBO}	Collector Cutoff Current (150°C)			25	μA	I_E = 0 V_{CB} = -15 V
t_{on}	Turn On Time		65		nsec	I_C = 10 mA, I_{B1} = I_{B2} = 1.0 mA
t_{off}	Turn Off Time		125		nsec	I_C = 10 mA, I_{B1} = I_{B2} = 1.0 mA
NF	Noise Figure (Note 6)		6		db	I_C = 100 μA V_{CE} = 5.0 V
η	100 Mc Oscillator Efficiency		40		%	I_C = 10 mA V_{CB} = -10 V
BV_{CBO}	Collector to Base Breakdown Voltage	-20			Volts	I_C = 10 μA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-15			Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			Volts	I_E = 10 μA I_C = 0

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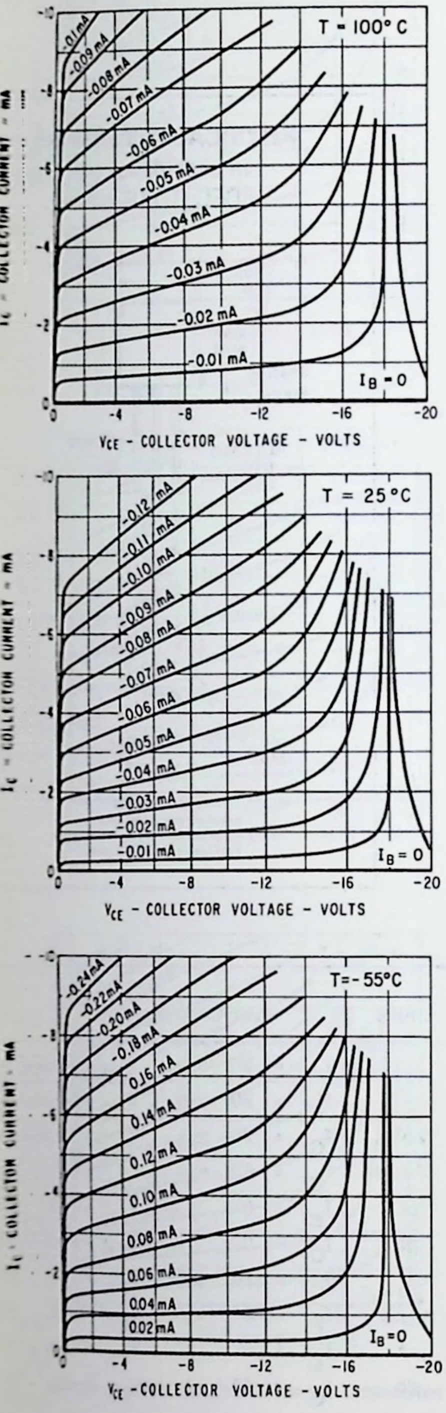
NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 145°C/Watt (derating factor of 6.9 mW/°C).
4. Rating refers to a high current point where collector-to-emitter voltage is lowest.
5. Pulse Conditions: length = 300 μsec; duty cycle ≤ 1%.
6. f = 1 Kc, Power Bandwidth of 200 cps, R_G = 2 K.

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

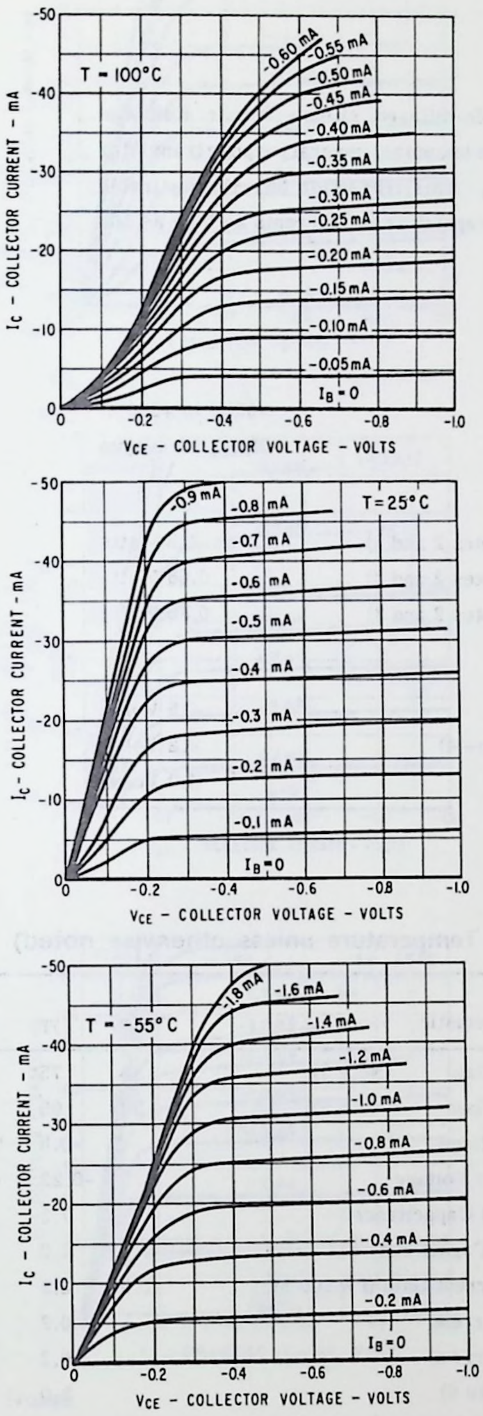
ACTIVE REGION

COLLECTOR CHARACTERISTICS

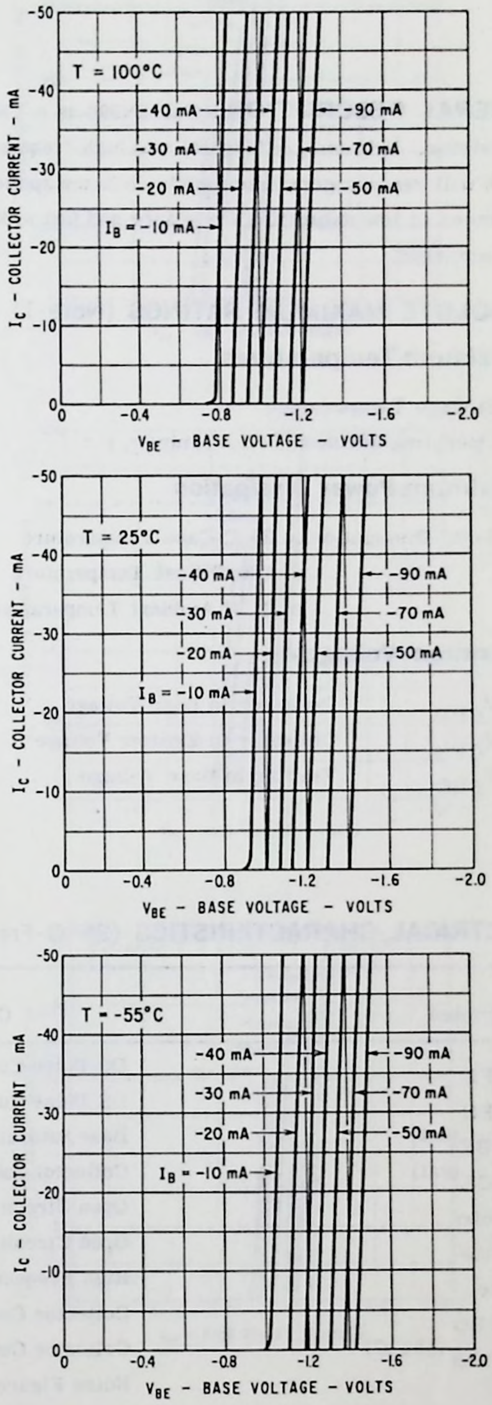


SATURATION REGION

COLLECTOR CHARACTERISTICS

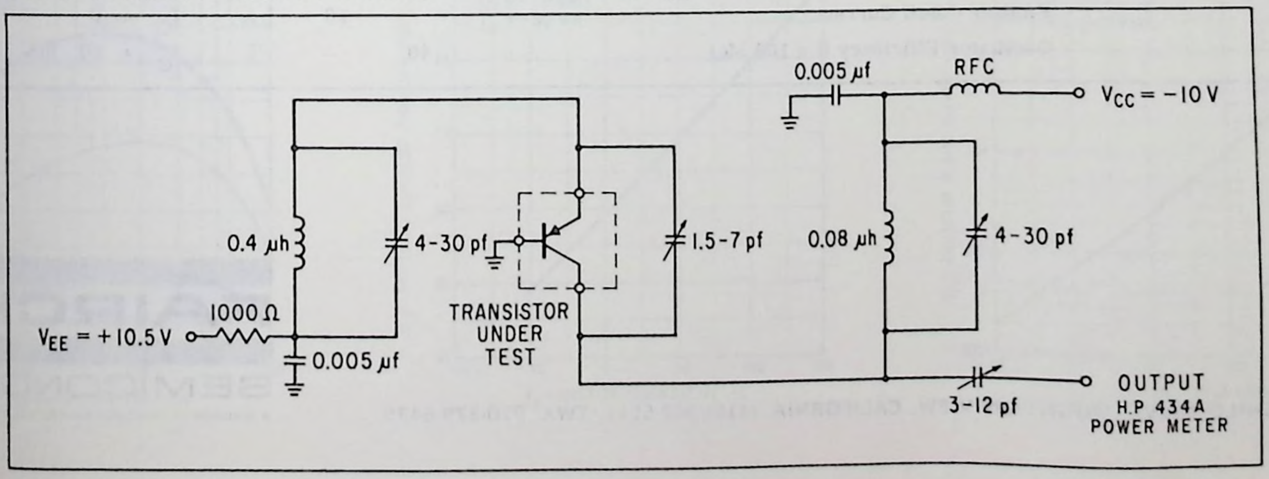


BASE CHARACTERISTICS



* Single family characteristic on Transistor Curve Tracer.

OSCILLATOR EFFICIENCY CIRCUIT ($I_C = 10\,mA$, $V_{CB} = -10V$)


0.005 μf
RFC
V_CC = -10 V
0.4 μh
4-30 pf
1.5-7 pf
0.08 μh
4-30 pf
1000 Ω
V_EE = +10.5 V
0.005 μf
TRANSISTOR
UNDER
TEST
3-12 pf
OUTPUT
H.P 434A
POWER METER

2N996

PNP HIGH SPEED SWITCH AND LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The 2N996 is a PNP double-diffused silicon Planar Epitaxial Transistor. It is designed for use as a high-frequency ultra low noise, general purpose transistor which will replace germanium units in many applications. This transistor has the desirable attributes of low saturation resistance and fast switching capabilities at currents as high as 100 milliamperes.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum

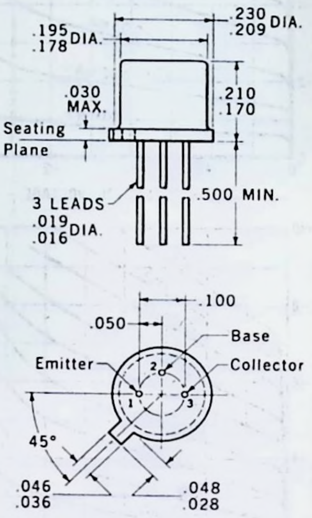
Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.2 Watts
at 100°C Case Temperature	(Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.36 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		-15 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-12 Volts
V_{EBO}	Emitter to Base Voltage		-4.0 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	35	75			I_C = 20 mA V_{CE} = -1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	65			I_C = 60 mA V_{CE} = -0.3 V
V_{BE}(sat)	Base Saturation Voltage		-0.8	-0.95	Volts	I_C = 20 mA I_B = 2.0 mA
V_{CE}(sat)	Collector Saturation Voltage		-0.22	-0.3	Volts	I_C = 60 mA I_B = 2.0 mA
C_{obo}	Open Circuit Output Capacitance		7.5	10	pf	I_E = 0 V_{CB} = -10 V
C_{ibo}	Open Circuit Input Capacitance		7.0	11	pf	I_C = 0 V_{EB} = -0.5 V
h_{fe}	High Frequency Current Gain (f = 100 Mc)	1.0	2.3			I_C = 10 mA V_{CE} = -10 V
I_{CBO}	Collector Cutoff Current		0.2	5.0	mμA	I_E = 0 V_{CB} = -10 V
I_{CBO} (150°C)	Collector Cutoff Current		0.2	15	μA	I_E = 0 V_{CB} = -10 V
NF	Noise Figure (Note 6)		3.0		db	I_C = 50 μA V_{CE} = -5.0 V
BV_{CBO}	Collector Breakdown Voltage	-15			Volts	I_C = 10 μA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-12			Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			Volts	I_E = 10 μA I_C = 0
I_{EBO}	Emitter Cutoff Current			10	μA	I_C = 0 V_{EB} = -4.0 V
η	Oscillator Efficiency (f = 100 Mc)		40		%	I_C = 10 mA V_{CB} = -7.0 V

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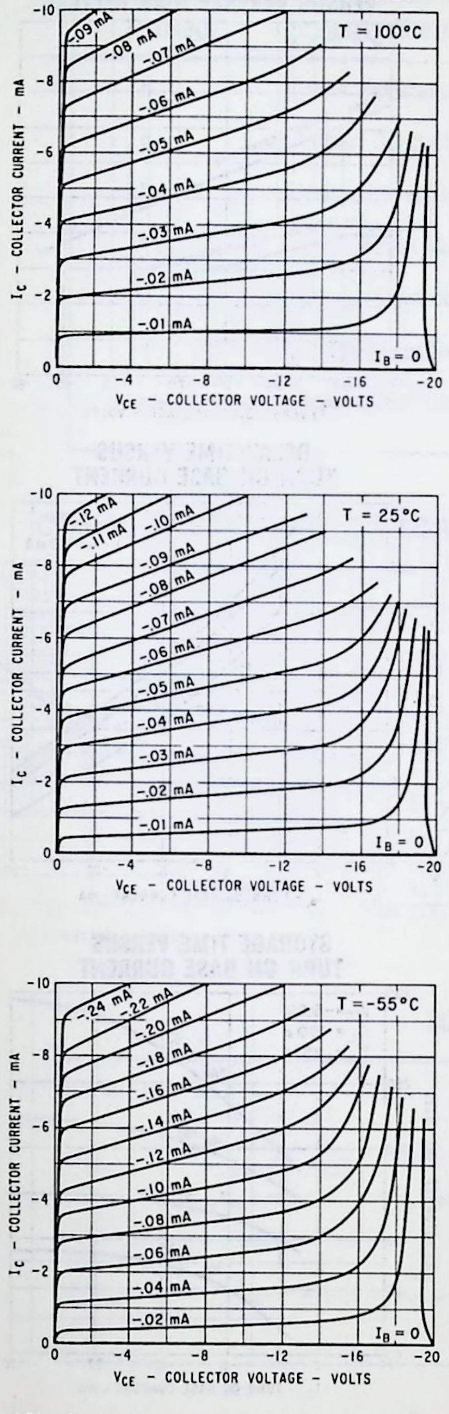
TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

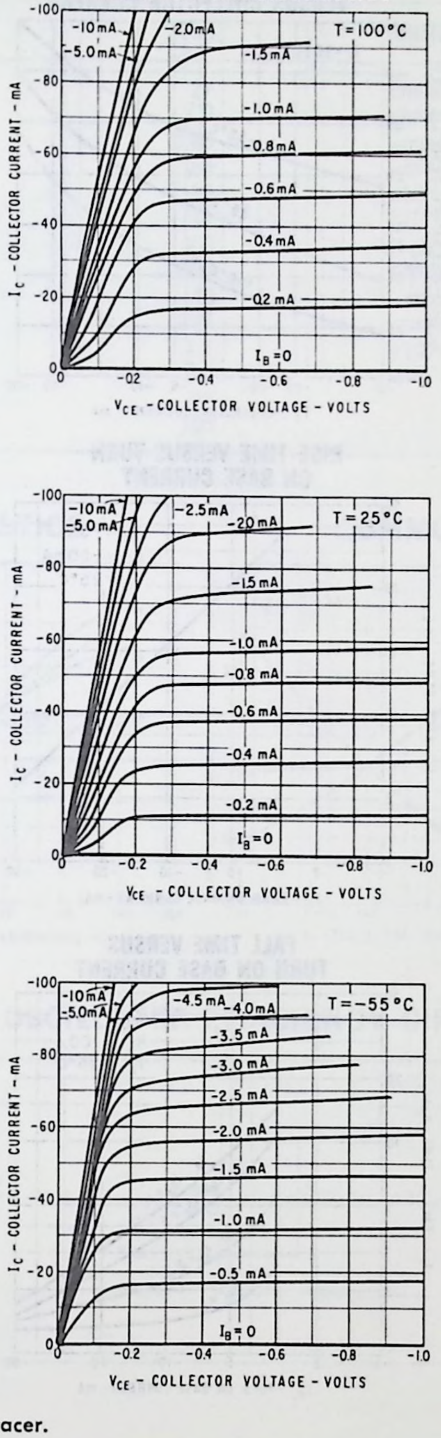
HIGH VOLTAGE

COLLECTOR CHARACTERISTICS

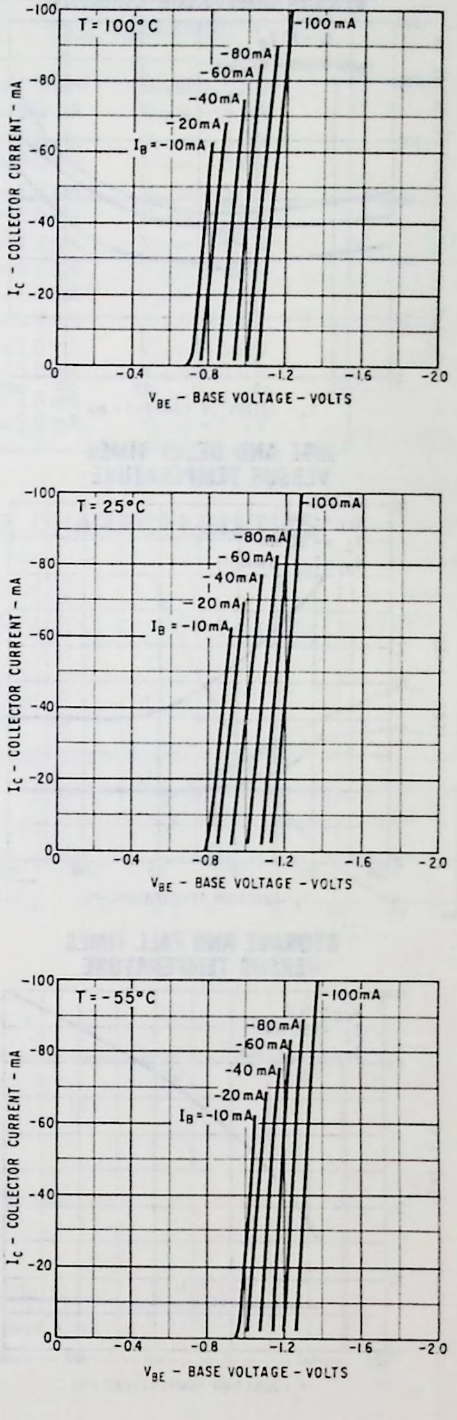


SATURATION REGION

COLLECTOR CHARACTERISTICS

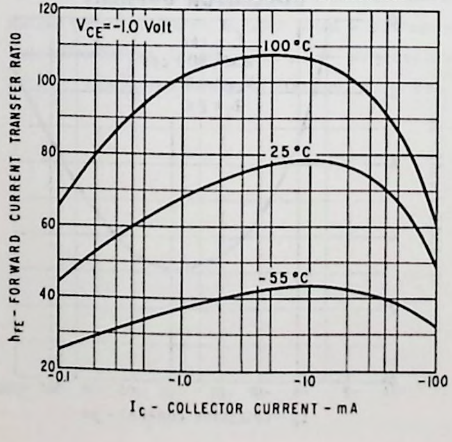


BASE CHARACTERISTICS

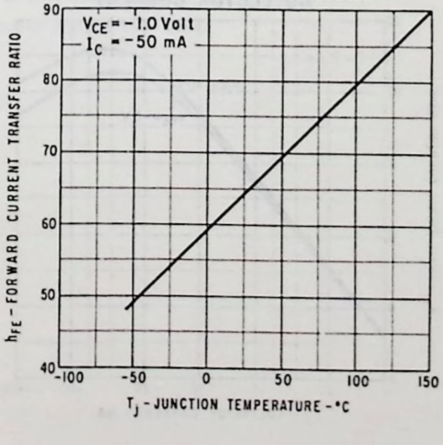


*Single family characteristics on Transistor Curve Tracer.

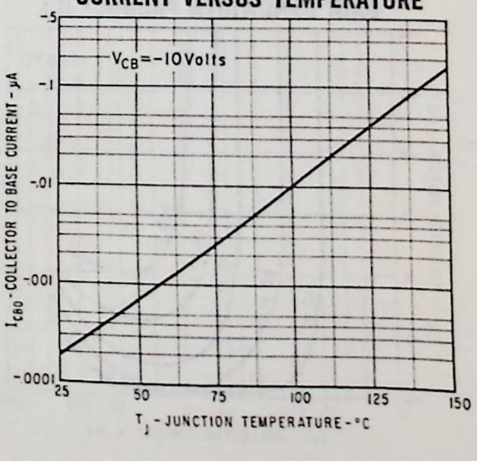
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



PULSED DC CURRENT GAIN VERSUS TEMPERATURE

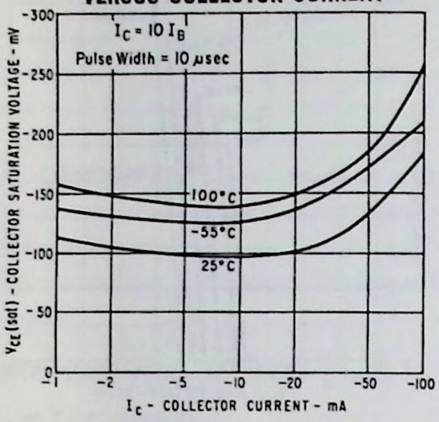


COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE

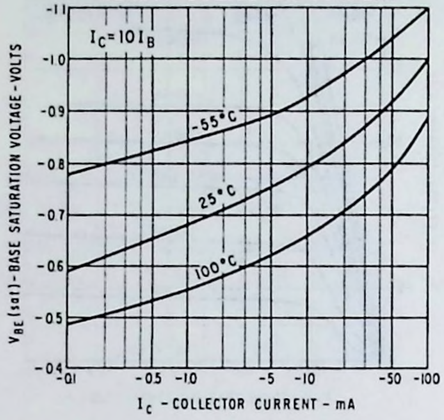


TYPICAL ELECTRICAL CHARACTERISTICS

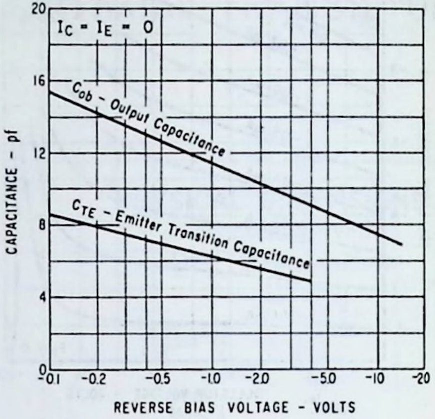
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



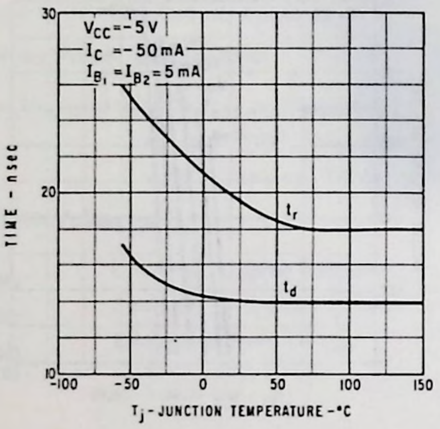
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



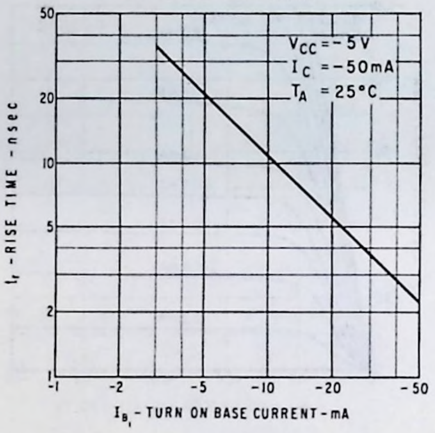
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



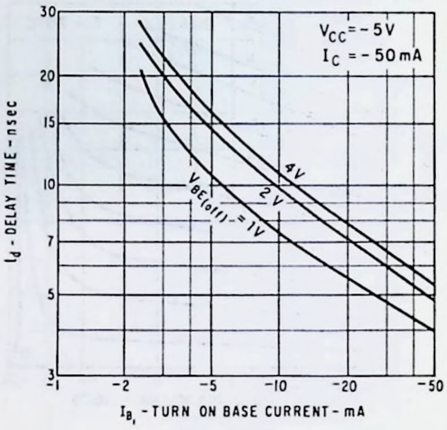
RISE AND DELAY TIMES VERSUS TEMPERATURE



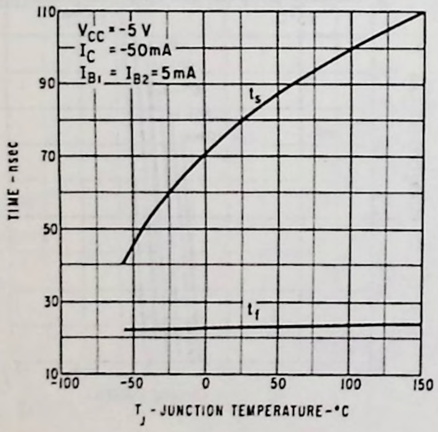
RISE TIME VERSUS TURN ON BASE CURRENT



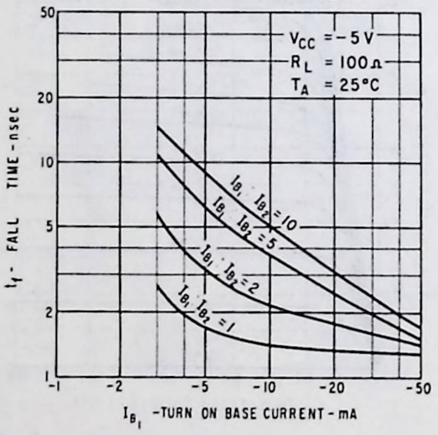
DELAY TIME VERSUS TURN ON BASE CURRENT



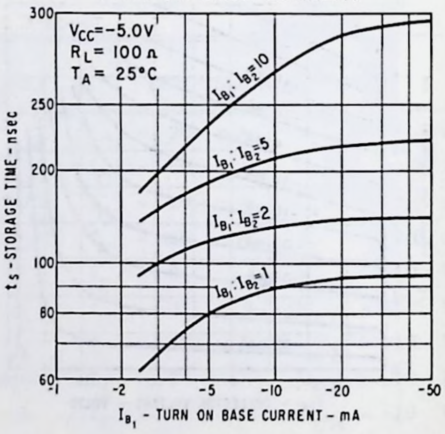
STORAGE AND FALL TIMES VERSUS TEMPERATURE



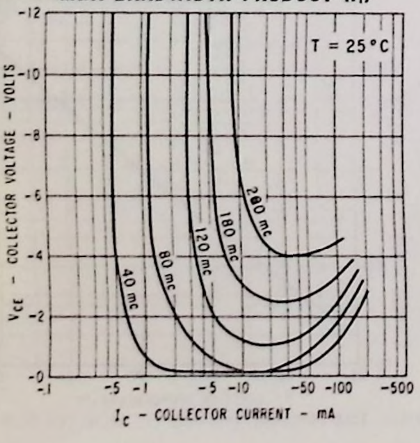
FALL TIME VERSUS TURN ON BASE CURRENT



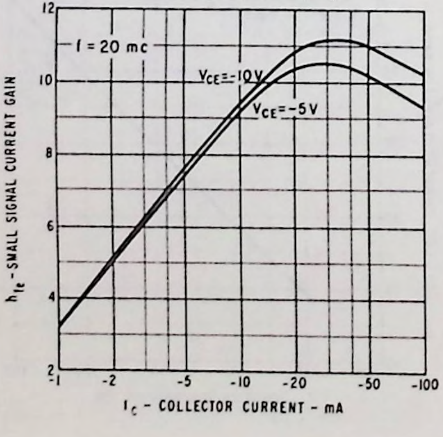
STORAGE TIME VERSUS TURN ON BASE CURRENT



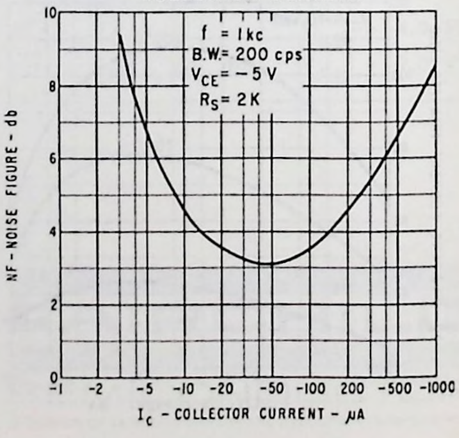
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



SMALL SIGNAL CURRENT GAIN AT 20 MC VERSUS COLLECTOR CURRENT



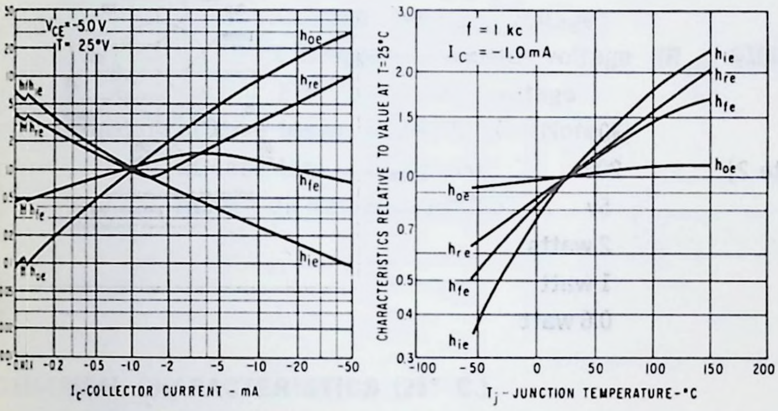
NOISE FIGURE VERSUS COLLECTOR CURRENT



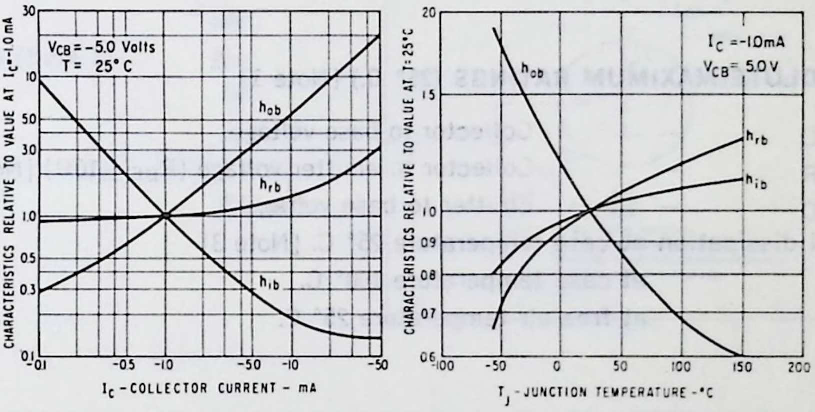
SMALL SIGNAL CHARACTERISTICS (f=1 KC)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS	
h_{ib}	Input Resistance	27	ohms	$I_C = 1.0$ mA	$V_{CB} = -5.0$ V
		7.0	ohms	$I_C = 5.0$ mA	$V_{CB} = -5.0$ V
h_{ob}	Output Conductance	0.65	μmhos	$I_C = 1.0$ mA	$V_{CB} = -5.0$ V
		5.5	μmhos	$I_C = 5.0$ mA	$V_{CB} = -5.0$ V
h_{rb}	Voltage Feedback Ratio	10	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = -5.0$ V
		14	$\times 10^{-4}$	$I_C = 5.0$ mA	$V_{CB} = -5.0$ V
h_{ie}	Input Resistance	2.0	K ohms	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
		800	ohms	$I_C = 5.0$ mA	$V_{CE} = -5.0$ V
h_{oe}	Output Conductance	40	μmhos	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
		200	μmhos	$I_C = 5.0$ mA	$V_{CE} = -5.0$ V
h_{re}	Voltage Feedback Ratio	1.4	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
		2.6	$\times 10^{-4}$	$I_C = 5.0$ mA	$V_{CE} = -5.0$ V
h_{fe}	Small Signal Current Gain	70		$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
		105		$I_C = 5.0$ mA	$V_{CE} = -5.0$ V

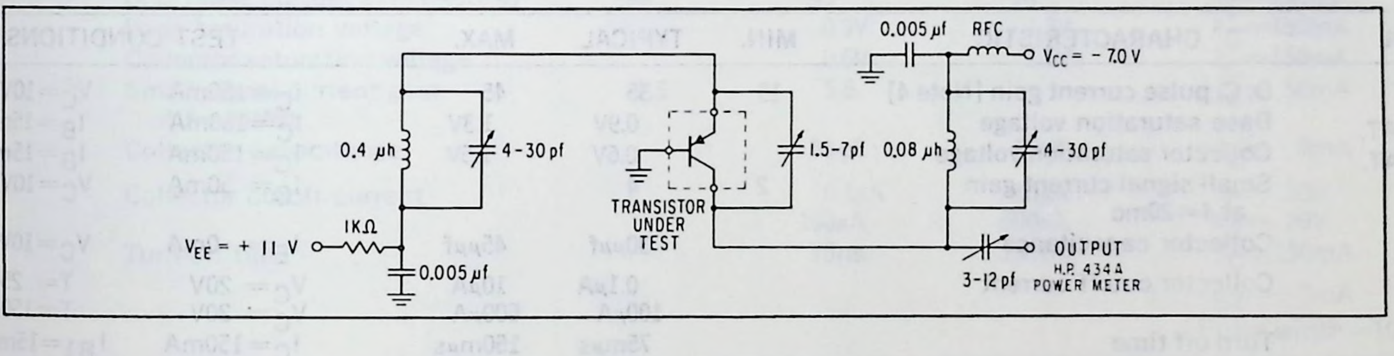
COMMON EMITTER CHARACTERISTICS



COMMON BASE CHARACTERISTICS



100 MC OSCILLATOR EFFICIENCY CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions; length = 300 µsec; duty cycle = 1%.

(6) f = 1 Kc; Power Bandwidth of 200 cps, R_G = 2 K.

2N1252

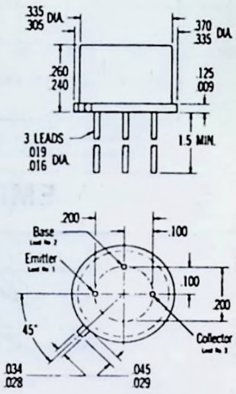
NPN LOW STORAGE TYPE

DIFFUSED SILICON TRANSISTOR

LOW STORAGE TIME – Low storage times and low saturation voltage make the 2N1252 ideal for all types of saturated circuitry from low logic levels to ½ ampere core driving levels. These units make 5 mc saturating switching circuits possible. Turn off time at 150 mA is guaranteed less than 150 millimicroseconds. Total switching times are typically 100 millimicroseconds at 500 mA.

BROAD OPERATING RANGE AND HIGH RELIABILITY – Power rating is 2 watts dissipation at 25° C. case temperature. At 150 mA, the base-on voltage is 1.3 volts and maximum saturation resistance is 10 ohms.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (25° C.) [Note 1]

V_{CBO}	–	Collector to base voltage	30v
V_{CER}	–	Collector to emitter voltage ($R_{BE} \leqq 10\Omega$) [Note 2]	20v
V_{EBO}	–	Emitter to base voltage	5v
Total dissipation at case temperature 25° C. [Note 3]			2 watts
		at case temperature 100° C.	1 watt
		at free air temperature 25° C.	0.6 watt

LECTRICAL CHARACTERISTICS (25° C.)

SYMBOL	CHARACTERISTIC	MIN.	TYPICAL	MAX.	TEST CONDITIONS	
h_{FE}	D. C. pulse current gain [Note 4]	15	35	45	I_C=150mA	V_C=10V
$V_{BE\ SAT.}$	Base saturation voltage		0.9V	1.3V	I_C=150mA	I_B=15mA
$V_{CE\ SAT.}$	Collector saturation voltage		0.6V	1.5V	I_C=150mA	I_B=15mA
h_{fe}	Small signal current gain at f=20mc	2	4		I_C= 50mA	V_C=10V
C_{ob}	Collector capacitance		30μμf	45μμf	I_E= 0mA	V_C=10V
I_{CBO}	Collector cutoff current		0.1μA 100μA	10μA 600μA	V_C= 20V V_C= 20V	T= 25° C. T=150° C.
t_s+t_f	Turn off time		75mμs	150mμs	I_C=150mA I_{B2}= 5mA Pulse width ≥ 10 μsec	I_{B1}=15mA R_L=40Ω

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NOTES:
(1) The maximum ratings are limiting absolute values above which life or satisfactory performance may be impaired.
(2) Rating refers to a high current point where collector-to-emitter voltage is lowest.
(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 75°C/watt (derating factor of 13.3 mw/°C).
(4) Pulse conditions: length = 300 μs.; duty cycle ≤ 1%.

2N1253

NPN LOW STORAGE TYPE

DIFFUSED SILICON PLANAR* TRANSISTOR

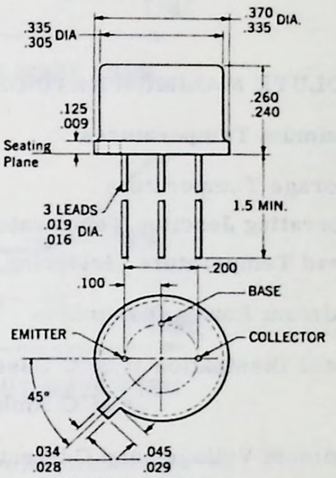
FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N2845

OW STORAGE TIME – Low storage times and low saturation voltage make the 2N1253 eal for all types of saturated circuitry from low logic levels to ½ ampere core driving levels. ese units make 5 MHz saturating switching circuits possible. Turn off time at 150 mA is aranteed less than 150 ns. Total switching times are typically 100 ns at 500 mA.

PHYSICAL DIMENSIONS

in accordance with

JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar*
Leads No. 3 internally connected to case
Package weight is 1.23 grams

SOLUTE MAXIMUM RATINGS (25° C.) [Note 1]

BO	—	Collector to base voltage	30v
CER	—	Collector to emitter voltage **(R_{BE} ≦10Ω) [Note 2]**	20v
EBO	—	Emitter to base voltage	5v
tal dissipation at case temperature 25° C. [Note 3]			2 watts
		at case temperature 100° C.	1 watt
		at free air temperature 25° C.	0.6 watt

ECTRICAL CHARACTERISTICS (25° C.)

SYMBOL	CHARACTERISTIC	MIN.	TYPICAL	MAX.	TEST CONDITIONS	
h_{FE}	D. C. pulse current gain [Note 4]	30	45	90	I_C=150mA	V_C=10V
$V_{BE\ SAT.}$	Base saturation voltage		0.9V	1.3V	I_C=150mA	I_B=15mA
$V_{CE\ SAT.}$	Collector saturation voltage		0.6V	1.5V	I_C=150mA	I_B=15mA
h_{fe}	Small signal current gain at f=20MHz	2.5	5.5		I_C= 50mA	V_C=10V
C_{obo}	Collector capacitance		30 pF	45 pF	I_E= 0mA	V_C=10V
I_{CBO}	Collector cutoff current		0.1μA 100μA	10μA 600μA	V_C= 20V V_C= 20V	T= 25° C. T=150° C.
t_s+t_f	Turn-off time		75ns	150 ns	I_C=150mA I_{B2}= 5mA Pulse width=10 μs	I_{B1}=10mA R_L=40Ω

* Planar is a patented Fairchild process.

TES:

The maximum ratings are limiting absolute values above which life or satisfactory performance may be impaired.
Rating refers to a high current point where collector-to-emitter voltage is lowest.
These ratings give a maximum junction temperature of 175°C. and junction-to-case thermal resistance of 75°C./watt (derating factor of 13.3 mw/°C.).
Pulse conditions: length = 300μs.; duty cycle ≦ 1%.

2N1708

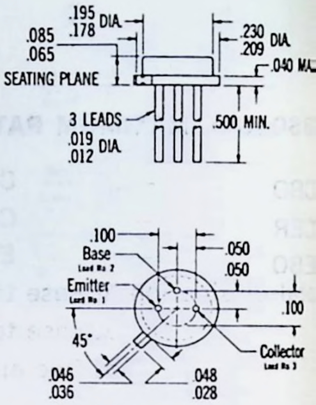
NPN HIGH-SPEED SWITCH

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

**FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N2368, 2N23
OR 2N2369A**

GENERAL DESCRIPTION - The Fairchild 2N1708 is an NPN silicon PLANAR epitaxial transistor designed specifically for high-speed, low-power saturated switching applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	-65°C to +300°C
Operating Junction Temperature	175°C Maximum
Lead Temperature (Soldering, 10 second time limit)	235°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.3 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	25 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	12 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts
I_C Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain	20			I_C = 10 mA	V_{CE} = 1.0 V
V_{BE}(sat)	Base Saturation Voltage	0.7	0.9	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.22	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.35	Volts	I_C = 50 mA	I_B = 5.0 mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	2.0			I_C = 10 mA	V_{CE} = 10 V
I_{CBO}	Collector-Base Cutoff Current		0.025	μA	I_E = 0	V_{CB} = 15 V
I_{CBO}(150°C)	Collector-Base Cutoff Current		15	μA	I_E = 0	V_{CB} = 15 V
I_{CEX}(100°C)	Collector Cutoff Current		15	μA	V_{CE} = 10 V	V_{BE} = 0.25 V
BV_{CBO}	Collector to Base Breakdown Voltage	25		Volts	I_E = 0	I_C = 100 μA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	12		Volts	I_B = 0	I_C = 10 mA (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		Volts	I_C = 0	I_E = 100 μA
C_{ob}	Output Capacitance (f = 140 kc)		6.0	pf	I_E = 0	V_{CB} = 10 V
τ_s	Charge Storage Time Constant (Note 6)		25	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA	
t_{on}	Turn On Time (Note 6)		40	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA, $I_{B2} \approx -1.0$ mA	
t_{off}	Turn Off Time (Note 6)		75	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA, $I_{B2} \approx -1.0$ mA	

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NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

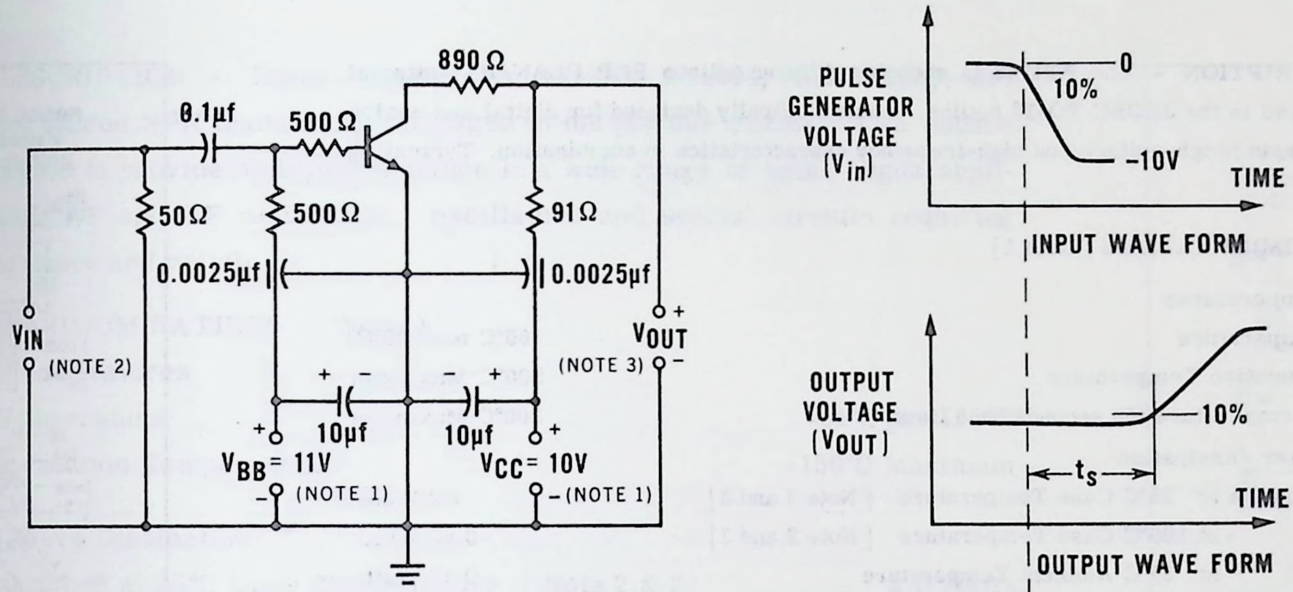
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C; junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length <6.0 msec; duty cycle <30%.

(6) See test circuit for exact values of I_C, I_{B1}, and I_{B2}.



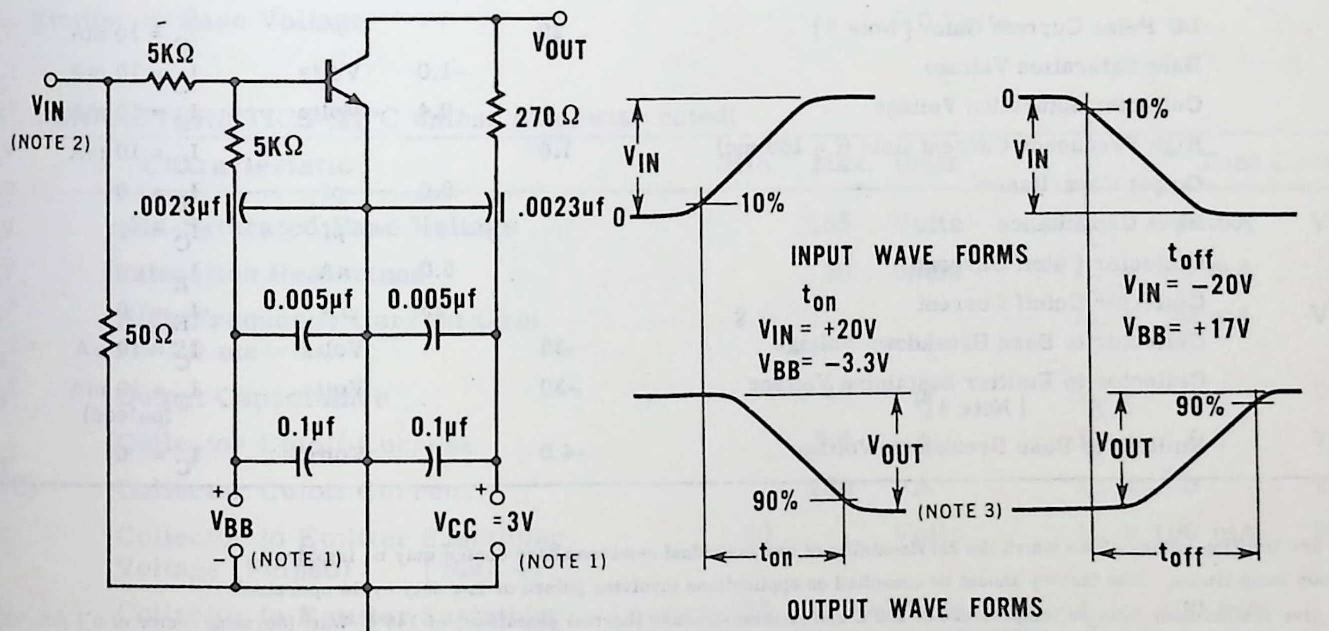
890 Ω
0.1μf
500 Ω
50Ω
500 Ω
91 Ω
0.0025μf
0.0025μf
V_IN
(NOTE 2)
V_OUT
(NOTE 3)
10μf
10μf
V_BB = 11V
V_CC = 10V
(NOTE 1)
(NOTE 1)
PULSE GENERATOR VOLTAGE (V_in)
0
10%
-10V
TIME
INPUT WAVE FORM
OUTPUT VOLTAGE (V_OUT)
10%
t_s
TIME
OUTPUT WAVE FORM

NOTES:

(1) Input voltage (V_{IN}) obtained from a pulse generator having an output impedance of 50 ohms. V_{IN} rise time <1 nsec; pulse duration >300 nsec, and duty factor <2%.

(2) Input and output waveforms, shown above, monitored by means of a sampling oscilloscope or other indicating device having rise time <0.5 nsec, input capacitance of probe <2.5 pf with shunt resistance >1000 ohms.

CIRCUIT USED TO MEASURE STORAGE TIME (τ_s).



5KΩ
V_IN
(NOTE 2)
5KΩ
V_OUT
270 Ω
.0023μf
.0023uf
50Ω
0.005μf
0.005μf
0.1μf
0.1μf
V_BB
V_CC = 3V
(NOTE 1)
(NOTE 1)
V_IN
0
10%
0
10%
V_IN
INPUT WAVE FORMS
t_on
V_IN = +20V
V_BB = -3.3V
t_off
V_IN = -20V
V_BB = +17V
V_OUT
90%
V_OUT
90%
(NOTE 3)
t_on
t_off
OUTPUT WAVE FORMS

NOTES:

(1) With certain types of power supplies, it may be necessary to connect 25-μf decoupling capacitors across the power-supply terminals for V_{CC} and V_{BB}.

(2) Input voltage (V_{IN}) obtained from a generator having an output impedance of 50 ohms. V_{IN} rise time <1 nsec; pulse duration >300 nsec, and duty factor <2%.

(3) Input and output waveforms, shown above, monitored by means of a sampling oscilloscope or other indicating device having rise time <0.5 nsec, input capacitance of probe <2.5 pf with shunt resistance >3000 ohms.

CIRCUIT USED TO MEASURE "TURN-ON" TIME (t_{on}) AND "TURN-OFF" TIME (t_{off}).

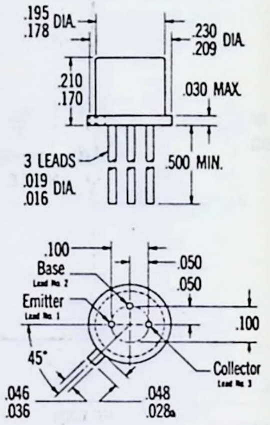
FT1746

FAIRCHILD PNP SILICON PLANAR EPITAXIAL TRANSISTOR

HIGH-VOLTAGE, HIGH-FREQUENCY SWITCH AND RF AMPLIFIER

GENERAL DESCRIPTION - The FT1746 is a double-diffused silicon PNP PLANAR epitaxial transistor packaged in the JEDEC TO-18 outline. It is specifically designed for digital and analog applications requiring high-voltage and high-frequency characteristics in combination. Typical f_T is 150 mc.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures		
Storage Temperature		-65°C to +200°C
Operating Junction Temperature		200°C Maximum
Soldering Temperature (60 seconds time limit)		300°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature	[Note 2 and 3]	1.2 Watts
at 100°C Case Temperature	[Note 2 and 3]	0.68 Watt
at 25°C Ambient Temperature		0.36 Watt
Maximum Voltages		
V_{CBO}	Collector to Base Voltage	-35 Volts
V_{CEO}	Collector to Emitter Voltage	-30 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain [Note 5]	20			I_C = 10 mA	V_{CE} = -5.0 V
V_{BE}(sat)	Base Saturation Voltage		-1.0	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		-0.4	Volts	I_C = 10 mA	I_B = 1.0 mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	1.0			I_C = 10 mA	V_{CE} = -10 V
C_{ob}	Output Capacitance		9.0	pf	I_E = 0	V_{CB} = -10 V
C_{TE}	Input Capacitance		11	pf	I_C = 0	V_{EB} = -0.5 V
I_{CBO}	Collector Cutoff Current		5.0	nA	I_E = 0	V_{CB} = -15 V
I_{CBO}(150°C)	Collector Cutoff Current		25	μA	I_E = 0	V_{CB} = -15 V
BV_{CBO}	Collector to Base Breakdown Voltage	-35		Volts	I_C = 10 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage [Note 4]	-30		Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		Volts	I_C = 0	I_E = 10 μA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.1 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse conditions: length = 300 μsec; duty cycle = 1%.

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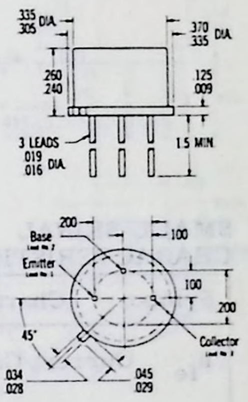
2N1983 · 2N1984 · 2N1985

NPN SMALL SIGNAL TYPE

DIFFUSED SILICON TRANSISTORS

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

GENERAL DESCRIPTION - These transistors: 2N1983, 2N1984, and 2N1985, are double diffused silicon NPN transistors packaged in the popular JEDEC TO-5 outline. They are designed to provide high performance in a wide range of small-signal applications including AF and RF amplifiers, oscillators and special circuits requiring silicon performance and reliability.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	-65°C to +150°C
Operating Junction Temperature	+150°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Note 2 & 3]	2.0 Watts
at 100°C Case Temperature [Note 2 & 3]	1.0 Watt
at 25°C Ambient Temperature	0.6 Watt
Maximum Voltages	
V_{CBO} — Collector to Base Voltage	50 Volts
V_{CER} — Collector to Emitter Voltage ($R_{BE} \leq 10\Omega$) [Note 4]	30 Volts
V_{CEO} — Collector to Emitter Voltage	25 Volts
V_{EBO} — Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{BE}	Non-Saturated Base Voltage		.85	Volts	I_C = 1.0 mA	V_{CE} = 5.0 V
R_{CS}	Saturation Resistance		50	ohms	I_C = 5.0 mA	I_B = 0.5 mA
h_{fe}	High Frequency Current Gain f = 20 mc	2.0			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		45	pf	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current		5.0	μA	I_E = 0	V_{CB} = 30 V
I_{CBO}(+150°C)	Collector Cutoff Current		200	μA	I_E = 0	V_{CB} = 30 V
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (Pulsed) [Note 4]	30		Volts	I_C = 100 mA	$R_{BE} \leq$ 10 Ω
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Pulsed) [Note 4]	25		Volts	I_C = 100 mA	I_B = 0
I_{EBO}	Emitter Current		100	μA	I_C = 0	V_{EB} = 2.0 V

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NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 150°C and junction-to-case thermal resistance of 62.5°C/Watt (derating factor of 16 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse conditions: length = 300 μsec; duty cycle $\leq$ 1%.

SMALL SIGNAL
CHARACTERISTICS (f = 1 kc)

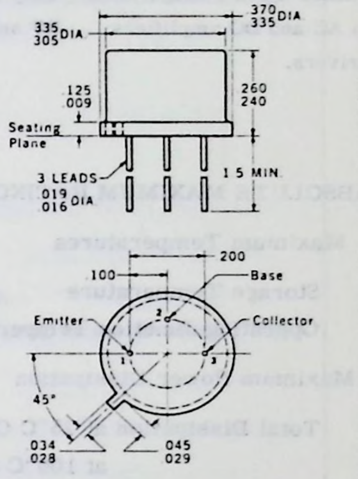
		2N1983		2N1984		2N1985			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{fe}	Current Gain	70	210	35	100	15	45		I_C = 1.0 mA V_{CE} = 5.0 V
		80	240	40	120	20	80		I_C = 5.0 mA V_{CE} = 5.0 V
h_{ib}	Input Resistance	20	30	20	30	20	30	ohms	I_C = 1.0 mA V_{CB} = 5.0 V
		4.0	8.0	4.0	8.0	4.0	8.0	ohms	I_C = 5.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		7.0		5.0		5.0	$\times 10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
			7.0		5.0		5.0	$\times 10^{-4}$	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		1.0		1.0		1.5	μmho	I_C = 1.0 mA V_{CB} = 5.0 V
			1.5		1.5		2.0	μmho	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ie}	Input Resistance		2000		1200		1000	ohms	I_C = 5.0 mA V_{CE} = 5.0 V
h_{oe}	Output Conductance		200		100		75	μmho	I_C = 5.0 mA V_{CE} = 5.0 V

2N1986 • 2N1987
NPN SWITCHES

DIFFUSED SILICON PLANAR* TRANSISTORS

GENERAL DESCRIPTION - The 2N1986 and 2N1987 are Double Diffused Silicon NPN Transistors packaged in the JEDEC TO-5 outline. They are designed for high-speed switching, high-frequency amplifier applications, and may be used as core drivers, relay drivers, and pulse generators.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 1.11 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature		-65°C to +150°C
Operating Junction Temperature		+150°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	2.0 Watts
at 100°C Case Temperature	(Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature		0.6 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	50 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\,\Omega$) (Note 4)	40 Volts
V_{CEO}	Collector to Emitter Voltage	25 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N1986 Min.	2N1986 Max.	2N1987 Min.	2N1987 Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	60	240	20	80		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	60		20			I_C = 30 mA	V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage		0.9		0.9	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.6		0.6	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{BE}(sat)	Base Saturation Voltage		1.3		1.3	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage		1.5		1.5	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0		2.0			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance		35		35	pF	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current		5.0		5.0	μA	I_E = 0	V_{CB} = 30 V
I_{CBO}(+150°C)	Collector Cutoff Current		200		200	μA	I_E = 0	V_{CB} = 30 V
BV_{CBO}	Collector Breakdown Voltage	40		40		Volts	I_C = 100 μA	I_E = 0
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (Note 4)	30		30		Volts	I_C = 100 mA (pulsed)	$R_{BE} \leq 10\,\Omega$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 4)	25		25		Volts	I_C = 100 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter Breakdown Voltage	5.0		5.0		Volts	I_C = 0	I_E = 1.0 mA

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 150°C and junction-to-case thermal resistance of 62.5°C/Watt (derating factor of 16 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse conditions: Length = 300 μsec; duty cycle ≤ 1%.

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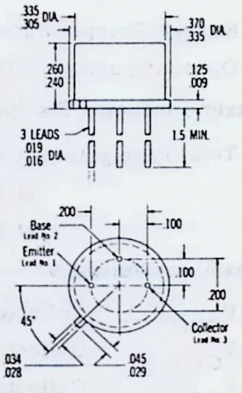
2N1988 · 2N1989
NPN HIGH-VOLTAGE
DIFFUSED SILICON PLANAR* TRANSISTORS

GENERAL DESCRIPTION - The 2N1988 and 2N1989 are double diffused silicon NPN transistors packaged in the popular JEDEC TO-5 configuration. They are characterized by high breakdown and sustaining voltages. They are designed for use in AC and DC amplifiers ... RF amplifiers and oscillators ... servo amplifiers ... and as relay, core, and drum memory drivers.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 1.1 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature		-65°C to +150°C
Operating Junction Temperature		+150°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 & 3)	2.0 Watts
at 100°C Case Temperature	(Notes 2 & 3)	1.0 Watt
at 25°C Ambient Temperature		0.6 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		100 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\Omega$)	(Note 4)	60 Volts
V_{CEO}	Collector to Emitter Voltage		45 Volts
V_{EBO}	Emitter to Base Voltage		5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C)

Symbol	Characteristics		2N1988 Min.	2N1988 Max.	2N1989 Min.	2N1989 Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain	(Note 5)	35	120	20	60		I_C = 30 mA	V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage			1.0		1.0	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{CE}(sat)	Collector Saturation Voltage			2.0		2.0	Volts	I_C = 30 mA	I_B = 3.0 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)		2.0		2.0			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance			20		20	pF	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current			5.0		5.0	μA	I_E = 0	V_{CB} = 50 V
I_{CBO}(+150°C)	Collector Cutoff Current			400		400	μA	I_E = 0	V_{CB} = 50 V
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (pulsed)	(Note 4)	60		60		Volts	I_C = 50 mA	$R_{BE} \geq 10\ \Omega$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (pulsed)	(Note 4)	45		45		Volts	I_C = 50 mA	I_B = 0
I_{EBO}	Emitter Current			100		100	μA	I_C = 0	V_{EB} = 2.0 V

* Planar is a patented Fairchild process.

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SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

Symbol	Characteristics	2N1988 Min.	2N1988 Max.	2N1989 Min.	2N1989 Max.	Units	Test Conditions
h_{fe}	Small Signal Current Gain	20	100	10			I_C = 1.0 mA V_{CE} = 5.0 V
h_{ib}	Input Resistance	20	30	20	30	ohms	I_C = 1.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		1.5		1.5	$\times 10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		1.0		1.0	μmho	I_C = 1.0 mA V_{CB} = 5.0 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 150°C and junction-to-case thermal resistance of 62.5°C/Watt (derating factor of 16 mW/°C).
4. Rating refers to a high current point where collector-to-emitter voltage is lowest.
5. Pulse conditions: length = 300 μsec; duty cycle $\leq 1\%$.

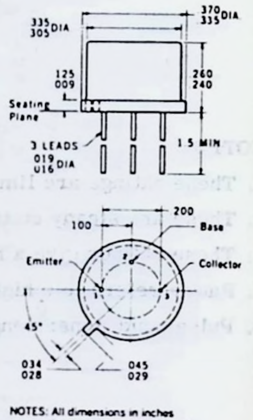
2N1990

NPN NEON TUBE AND NIXIE® DRIVER

DIFFUSED SILICON PLANAR* TRANSISTOR

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

GENERAL DESCRIPTION - The 2N1990 is a double diffused silicon NPN transistor packaged in the popular JEDEC TO-5 outline. The high breakdown voltage and low saturation voltage, plus diffused silicon performance and reliability, characterize it as an ideal unit for neon tube and nixie driver applications.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature		-65°C to +150°C
Operating Junction Temperature		+150°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 & 3)	2.0 Watts
at 100°C Case Temperature	(Notes 2 & 3)	1.0 Watt
at 25°C Ambient Temperature		0.6 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	100 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic		Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain	(Note 4)	20			I_C = 30 mA	V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage			1.0	Volts	I_C = 2.0 mA	I_B = 0.2 mA
V_{CE}(sat)	Collector Saturation Voltage			0.5	Volts	I_C = 2.0 mA	I_B = 0.2 mA
I_{CEX}	Cutoff Current, Reverse Bias			10	µA	I_B = -10 µA	V_{CE} = 75 V
I_{CEX}(+150°C)	Cutoff Current, Reverse Bias			250	µA	I_B = -250 µA	V_{CE} = 75 V

*Planar is a patented Fairchild proces

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 150°C and junction-to-case thermal resistance of 62.5°C/Watt (derating factor of 16 mW/°C).
4. Pulse Conditions: length = 300 µs ; duty cycle ≤1%.

NIXIE® - Registered Trade Mark Burroughs Corporatio

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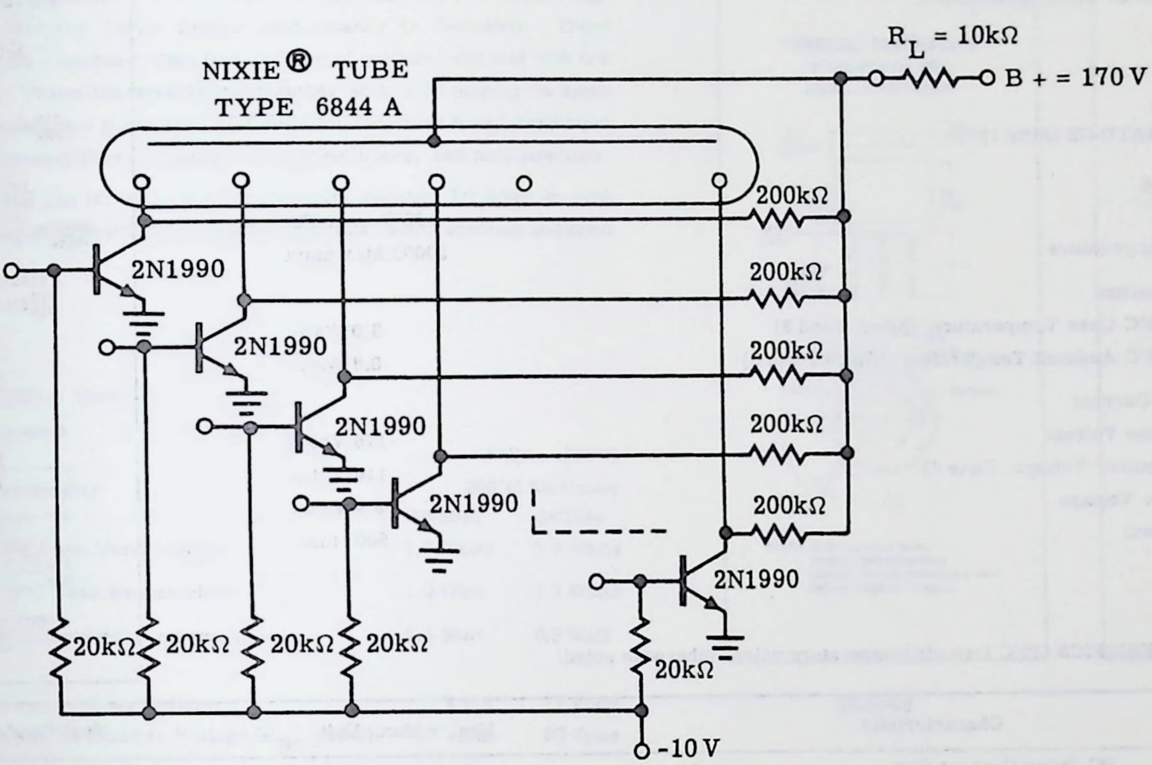
2N1990 FAIRCHILD TRANSISTOR

TRANSISTORIZED NIXIE® INDICATOR


NIXIE® TUBE
TYPE 6844 A
R_L = 10kΩ
B + = 170 V
200kΩ
200kΩ
200kΩ
200kΩ
200kΩ
2N1990
2N1990
2N1990
2N1990
2N1990
20kΩ
20kΩ
20kΩ
20kΩ
20kΩ
-10 V

2N2008

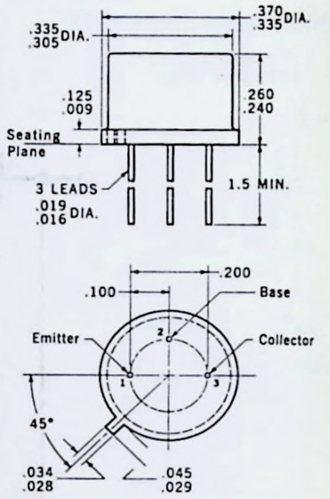
NPN MEDIUM POWER AUDIO AMPLIFIER

SILICON PLANAR* TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3114

GENERAL DESCRIPTION- The Fairchild 2N2008 is an NPN silicon PLANAR transistor designed primarily for large-signal, medium-power audio applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	-65°C to 200°C
Operating Junction Temperature	200°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	3.0 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.8 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	175 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	110 Volts
V_{EBO} Emitter to Base Voltage	8.0 Volts
I_C Collector Current	500 mA

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Unit	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	40	120		I_C = 50 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain	30	90		I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain	20			I_C = 1.0 mA	V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage		1.0	Volts	I_C = 25 mA	I_B = 5.0 mA
V_{CE}(sat)	Collector Saturation Voltage		2.5	Volts	I_C = 25 mA	I_B = 5.0 mA
h_{ib}	Input Resistance (f = 1 kHz)	20	30	Ohms	I_E = 1.0 mA	V_{CB} = 5.0 V
h_{ib}	Input Resistance (f = 1 kHz)	4.0	10	Ohms	I_E = 5.0 mA	V_{CB} = 5.0 V
h_{ob}	Output Conductance (f = 1 kHz)	0.1	0.5	μmhos	I_E = 1.0 mA	V_{CB} = 5.0 V
h_{ob}	Output Conductance (f = 1 kHz)	0.1	0.5	μmhos	I_E = 5.0 mA	V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio (f = 1 kHz)		250	$x10^{-6}$	I_E = 1.0 mA	V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio (f = 1 kHz)		250	$x10^{-6}$	I_E = 5.0 mA	V_{CB} = 5.0 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	20	100		I_E = 1.0 mA	V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	35	120		I_E = 5.0 mA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0			I_E = 50 mA	V_{CE} = 10 V
I_{CBO}	Collector-Base Cutoff Current		50	nA	I_E = 0	V_{CB} = 100 V
I_{CBO}(150°C)	Collector-Base Cutoff Current		50	μA	I_E = 0	V_{CB} = 100 V
C_{obo}	Output Capacitance (f = 1.0 mc)		15	pF	I_E = 0	V_{CB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	175		Volts	I_E = 0	I_C = 100 μA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	110		Volts	I_B = 0	I_C = 10 mA (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0		Volts	I_C = 0	I_E = 100 μA

NOTES

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/watt (derating factor of 17.2 mW/°C); junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.56 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length ≤ 300 μsec; duty cycle = 1%.

* Planar is a patented Fairchild proces

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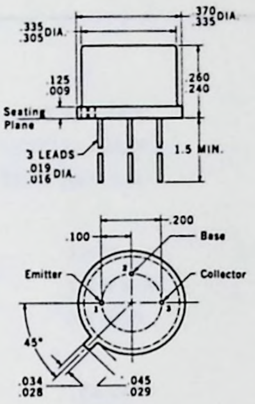
2N2049 • 2N2645

NPN LOW NOISE, HIGH GAIN

DIFFUSED SILICON PLANAR* TRANSISTORS

GENERAL DESCRIPTION - The 2N2049 and 2N2645 are designed for use in a broad range of amplifier and oscillator circuits where Planar performance is desirable. These transistors provide useful gain over more than five decades of collector current with low leakage and very low noise. These characteristics together with a 35 megacycle alpha cutoff at one milliampere make them particularly suitable for low-level broad-band input stages such as TV camera preamplifiers, transducer preamplifiers, and null detectors. The very low corner (typically 220 Hz at 10 μA) substantially reduces 1/f noise in such applications as tape recorder preamplifiers, digital voltmeters, audio systems and servo amplifiers.

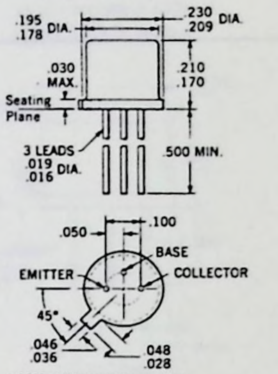
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 1.1 grams

2N2049

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated Kovar*
Lead No. 3 internally connected to case
Package weight is 0.44 gram

2N2645

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
Storage Temperature		-65°C to +300°C	
Operating Junction Temperature		200°C Maximum	
Maximum Power Dissipation		2N2645	2N2049
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		1.8 Watts	3.0 Watts
Total Dissipation at 100°C Case Temperature (Notes 2 and 3)		1.0 Watt	1.7 Watts
Total Dissipation at 25°C Ambient Temperature		0.5 Watt	0.8 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	75 Volts	75 Volts
V_{CER}	Collector to Emitter Voltage ($R_{BE} \leq 10\,\Omega$) (Note 4)	50 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts	7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
NF	Narrow-Band Noise Figure (Note 5)		0.6	2.5	dB	I_C = 0.1 mA V_{CE} = 10 V
NF	Narrow-Band Noise Figure (Note 6)		1.4	3.0	dB	I_C = 0.1 mA V_{CE} = 10 V
NF	Broad-Band Noise Figure (Note 7)			3.5	dB	I_C = 0.01 mA V_{CE} = 5 V
NF	Narrow-Band Noise Figure (Note 8)		7.5	12	dB	I_C = 0.1 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 9)	100	130	300		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	60	80			I_C = 0.1 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	20	55			I_C = 0.01 mA V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage	0.6	0.7	0.8	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.12	0.4	Volts	I_C = 10 mA I_B = 1.0 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.5	4.3			I_C = 10 mA V_{CE} = 10 V
C_{obo}	Output Capacitance		17	25	pF	I_E = 0 V_{CB} = 10 V
C_{ibo}	Input Capacitance		50	80	pF	I_C = 0 V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		0.4	10	nA	I_E = 0 V_{CB} = 60 V
I_{CBO}(150°C)	Collector Cutoff Current		0.4	10	μA	I_E = 0 V_{CB} = 60 V
BV_{CBO}	Collector to Base Breakdown Voltage	75			Volts	I_C = 0.1 mA I_E = 0
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (Note 4)	50			Volts	I_C = 100 mA (pulsed) $R_{BE} \leq$ 10 Ω
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			Volts	I_C = 0 I_E = 0.1 mA
I_{EBO}	Emitter Cutoff Current		0.03	10	nA	I_C = 0 V_{EB} = 5.0 V

*Planar is a patented Fairchild process.

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SMALL SIGNAL CHARACTERISTICS (f=1kHz)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{ib}	Input Resistance	24	27	34	Ohms	I_C = 1.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance	0.1	0.17	0.5	μmho	I_C = 1.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		1.25	5.0	$x10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
h_{fe}	Small Signal Current Gain	75	110			I_C = 1.0 mA V_{CE} = 5.0 V
h_{ie}	Input Resistance		4.4		kOhms	I_C = 1.0 mA V_{CE} = 5.0 V
h_{oe}	Output Conductance		23.8		μmho	I_C = 1.0 mA V_{CE} = 5.0 V
h_{re}	Voltage Feedback Ratio		7.3		$x10^{-4}$	I_C = 1.0 mA V_{CE} = 5.0 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C) for the 2N2049 and 97.2°C/Watt (derating factor of 10.3 mW/°C) for the 2N2645.

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) f = 10kHz; R_S = 2 kΩ; Power Bandwidth of 2kHz.

(6) f = 1kHz; R_S = 2 kΩ; Power Bandwidth of 200 Hz.

(7) R_S = 10 kΩ; Power Bandwidth of 15.7kHz with 3-dB points at 10 Hz and 10 kHz.

(8) f = 100 Hz ; R_S = 2 kΩ; Power Bandwidth of 20 Hz .

(9) Pulse Conditions: length = 300 μs ; duty cycle = 1%.

2N2192 · 2N2192A · 2N2192B

NPN HIGH-SPEED, HIGH-CURRENT SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N2297

GENERAL DESCRIPTION - The Fairchild 2N2192, 2N2192A, and 2N2192B are NPN silicon PLANAR epitaxial transistors designed for use in high-speed, high-current switching applications.

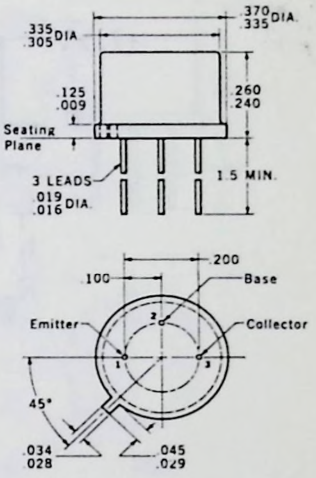
ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	-65°C to +300°C
Operating Junction Temperature	-65°C to +200°C
Lead Temperature (Soldering, No Time Limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	2.8 Watts
at 100°C Case Temperature (Notes 2 and 3)	1.6 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.8 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	1.0 Amp

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic		Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)		100	300		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain		75			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)		70			I_C = 150 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)		35			I_C = 500 mA	V_{CE} = 10 V
h_{FE}(-55°C)	DC Current Gain		35			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)		15			I_C = 1.0 A	V_{CE} = 10 V
h_{FE}	DC Current Gain		15			I_C = 0.1 mA	V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage	2N2192		0.35	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage	2N2192A		0.25	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage	2N2192B		0.18	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage			1.3	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 mc)		2.5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 1.0 mc)			20	pf	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current			10	nA	I_E = 0	V_{CB} = 30 V
I_{CBO}(150°C)	Collector Cutoff Current			15	μA	I_E = 0	V_{CB} = 30 V
I_{EBO}	Emitter Cutoff Current			50	nA	I_C = 0	V_{EB} = 3.0 V
BV_{CBO}	Collector to Base Breakdown Voltage		60		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)		40		Volts	I_C = 25 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage		5.0		Volts	I_E = 100 μA	I_C = 0
t_f	Fall Time			50	nsec	See Figure 1	
t_r	Rise Time			70	nsec	See Figure 1	
t_s	Storage Time			150	nsec	See Figure 1	

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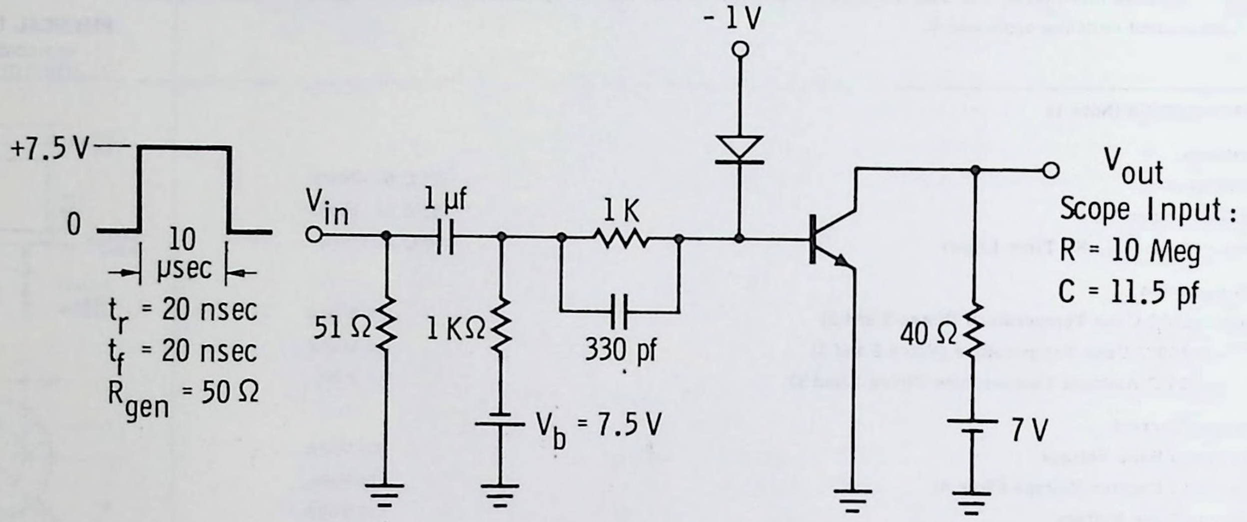

-1V
+7.5V
0
10 μsec
t_r = 20 nsec
t_f = 20 nsec
R_{gen} = 50 Ω
V_{in}
1 μf
51 Ω
1 KΩ
1 K
330 pf
V_b = 7.5 V
V_{out}
Scope Input:
R = 10 Meg
C = 11.5 pf
40 Ω
7 V

FIGURE 1

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 62.5°C/Watt (derating factor of 16 mW/°C), junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length $\leq$ 300 μsec, duty cycle $\leq$ 2%.

Fairchild cannot assume responsibility for use of any circuitry described. No circuit patent licenses are implied.

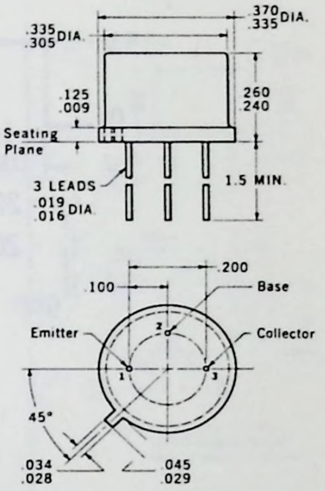
2N2193 · 2N2193A · 2N2193B

NPN HIGH-SPEED HIGH-CURRENT SWITCHES

SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3108

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

GENERAL DESCRIPTION - The Fairchild 2N2193, 2N2193A, and 2N2193B are NPN silicon PLANAR epitaxial transistors designed for use in high-speed, high-current switching applications.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		-65°C to +300°C
Operating Junction Temperature		-65°C to +200°C
Lead Temperature (Soldering, No Time Limit)		300°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		2.8 Watts
at 100°C Case Temperature (Notes 2 and 3)		1.6 Watts
at 25°C Ambient Temperature (Notes 2 and 3)		0.8 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	50 Volts
V_{EBO}	Emitter to Base Voltage	8.0 Volts
I_C	Collector Current	1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic		Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)		40	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain		30			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)		30			I_C = 150 mA	V_{CE} = 1.0 V
h_{FE}(-55°C)	DC Current Gain		20			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain		20			I_C = 500 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain		15			I_C = 1.0 A	V_{CE} = 10 V
h_{FE}	DC Current Gain		15			I_C = 0.1 mA	V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage	2N2193		0.35	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage	2N2193A		0.25	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage	2N2193B		0.18	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage			1.3	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)		2.5			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance (f = 1.0 MHz)			20	pf	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current			10	nA	I_E = 0	V_{CB} = 60 V
I_{CBO} (150°C)	Collector Cutoff Current			25	μA	I_E = 0	V_{CB} = 60 V
I_{EBO}	Emitter Cutoff Current			50	nA	I_C = 0	V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage		80		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)		50		Volts	I_C = 25 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage		8.0		Volts	I_E = 100 μA	I_C = 0
t_f	Fall Time			50	nsec	See Figure 1	
t_r	Rise Time			70	nsec	See Figure 1	
t_s	Storage Time			150	nsec	See Figure 1	

* Planar is a patented Fairchild process.

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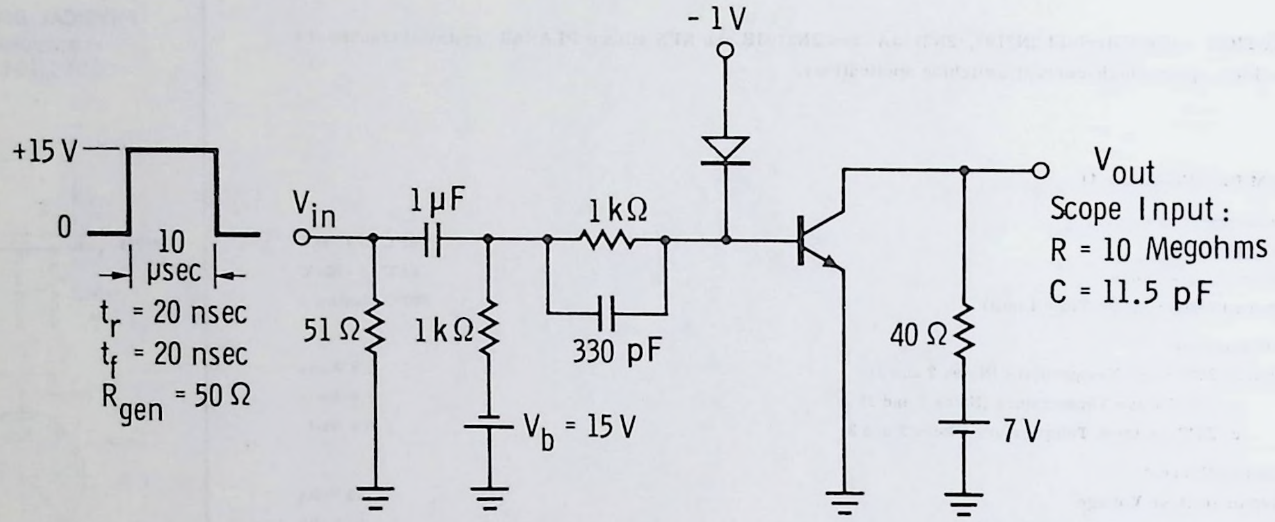

+15 V
0
10 μsec
t_r = 20 nsec
t_f = 20 nsec
R_{gen} = 50 Ω
V_{in}
1 μF
51 Ω
1 kΩ
V_b = 15 V
1 kΩ
330 pF
- 1 V
40 Ω
7 V
V_{out}
Scope Input:
R = 10 Megohms
C = 11.5 pF

FIGURE 1

NOTES

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 62.5°C/watt (derating factor of 16 mW/°C); junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.56 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

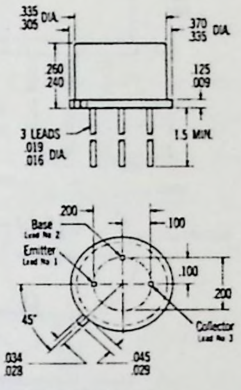
(5) Pulse Conditions: length ≤ 300 μsec, duty cycle ≤ 2%.

2N2194 · 2N2194A · 2N2194B
NPN HIGH-SPEED, HIGH-CURRENT SWITCHES
SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE
SEE FAIRCHILD 2N2297

GENERAL DESCRIPTION - The Fairchild 2N2194, 2N2194A, and 2N2194B are NPN silicon PLANAR epitaxial transistors designed for use in high-speed, high-current switching applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	-65°C to +200°C
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	2.8 Watts
at 100°C Case Temperature (Notes 2 and 3)	1.6 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.8 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	20	60		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	15			I_C = 150 mA V_{CE} = 1.0 V
h_{FE}	DC Current Gain	15			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	12			I_C = 500 mA V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage 2N2194		0.35	Volts	I_C = 150 mA I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage 2N2194A		0.25	Volts	I_C = 150 mA I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage 2N2194B		0.18	Volts	I_C = 150 mA I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage		1.3	Volts	I_C = 150 mA I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 mc)	2.5			I_C = 50 mA V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 1 mc)		20	pf	I_E = 0 V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0 V_{CB} = 30 V
I_{CBO}(150°C)	Collector Cutoff Current		25	μA	I_E = 0 V_{CB} = 30 V
I_{EBO}	Emitter Cutoff Current		50	nA	I_C = 0 V_{EB} = 3.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	60		Volts	I_C = 100 μA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40		Volts	I_C = 25 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	I_E = 100 μA I_C = 0
t_f	Fall Time		50	nsec	See Figure 1
t_r	Rise Time		70	nsec	See Figure 1
t_s	Storage Time		150	nsec	See Figure 1

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NOTES:

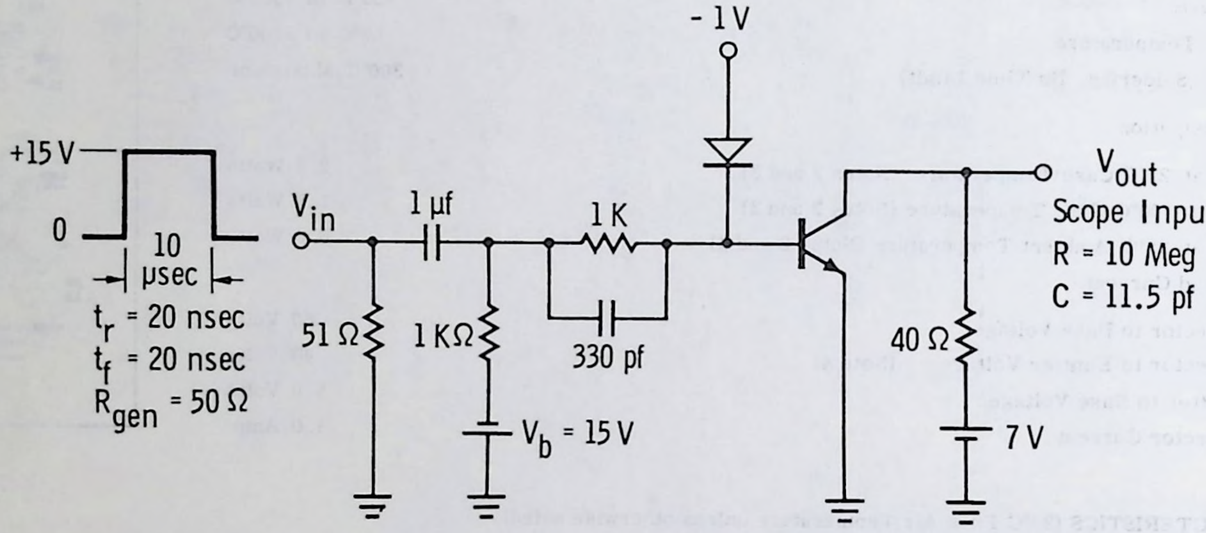
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 62.5°C/Watt (derating factor of 16 mW/°C; junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length ≤300 μsec; duty cycle ≤2%.



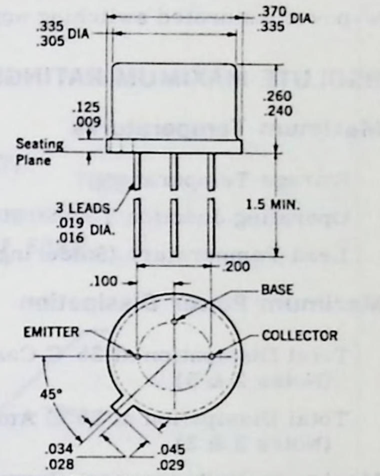
- 1 V
+15 V
0
10 μsec
t_r = 20 nsec
t_f = 20 nsec
R_{gen} = 50 Ω
V_{in}
1 μf
51 Ω
1 KΩ
1 K
330 pf
V_b = 15 V
V_{out}
Scope Input:
R = 10 Meg
C = 11.5 pf
40 Ω
7 V

FIGURE 1

2N2195 • 2N2195A • 2N2195B
GENERAL PURPOSE AMPLIFIERS AND SWITCHES
DIFFUSED SILICON PLANAR*EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The Fairchild 2N2195, 2N2195A, and 2N2195B are NPN silicon PLANAR epitaxial transistors designed for use in general purpose amplifier and switching applications.

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3110



NOTES: All dimensions in inches
Leads are gold-plated Kovar*
Leads No. 3 internally connected to case
Package weight is 1.23 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	-65°C to +300°C
Operating Junction Temperature	-65°C to +200°C
Lead Temperature (Soldering, No Time Limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	2.8 Watts
at 100°C Case Temperature (Notes 2 and 3)	1.6 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.6 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	45 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	25 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts
I_C Collector Current	1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic		Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)		20			I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)		10			I_C = 150 mA	V_{CE} = 1.0 V
$V_{CE}(sat)$	Collector Saturation Voltage	2N2195		0.35	Volts	I_C = 150 mA	I_B = 15 mA
$V_{CE}(sat)$	Collector Saturation Voltage	2N2195A		0.25	Volts	I_C = 150 mA	I_B = 15 mA
$V_{CE}(sat)$	Collector Saturation Voltage	2N2195B		0.18	Volts	I_C = 150 mA	I_B = 15 mA
$V_{BE}(sat)$	Base Saturation Voltage			1.3	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)		2.5			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance (f = 1.0 MHz)			20	pF	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current			100	nA	I_E = 0	V_{CB} = 30 V
$I_{CBO}(150°C)$	Collector Cutoff Current			50	μA	I_E = 0	V_{CB} = 30 V
I_{EBO}	Emitter Cutoff Current			100	nA	I_C = 0	V_{EB} = 3.0 V
BV_{CBO}	Collector to Base Breakdown Voltage		45		Volts	I_C = 100 μA	I_E = 0
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)		25		Volts	I_C = 25 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage		5.0		Volts	I_E = 100 μA	I_C = 0

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 62.5°C/watt (derating factor of 16 mW/°C); junction-to-ambient thermal resistance of 292°C/watt (derating factor of 3.42 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length ≤ 300 μs ; duty cycle ≤ 2%.

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2N2205 • 2N2206

NPN HIGH-SPEED SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N2368 • 2N2369 OR 2N2369A

GENERAL DESCRIPTION - The Fairchild 2N2205 and 2N2206 are NPN silicon PLANAR epitaxial transistors designed specifically for high-speed, low-power saturated switching applications.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	-65°C to +175°C
Lead Temperature (Soldering, 10 sec time limit)	+235°C

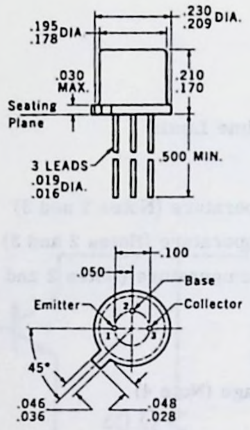
Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 & 3)	1.0 Watt
Total Dissipation at 25°C Ambient Temperature (Notes 2 & 3)	0.3 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	25 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	12 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	200 mA

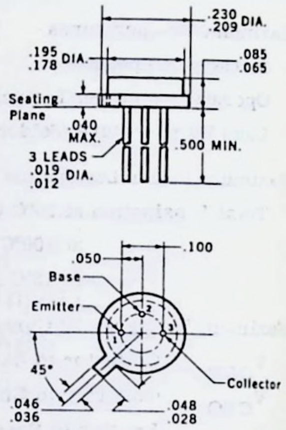
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

2N2205

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

2N2206

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N2205		2N2206			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{FE}	DC Current Gain	20		40	120		I_C = 10 mA V_{CE} = 1.0 V
V_{BE}(sat)	Base Saturation Voltage	0.7	0.9	0.7	0.9	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.22		0.22	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.35		0.35	Volts	I_C = 50 mA I_B = 5.0 mA
h_{fe}	Small Signal Current Gain (f = 100 Mc)	2.0		2.0			I_C = 10 mA V_{CE} = 10 V
C_{obo}	Common-Base, Open-Circuit Output Capacitance		6.0		6.0	pf	I_E = 0 V_{CB} = 10 V
I_{CBO}	Collector-Base Cutoff Current		0.025		0.025	µA	I_E = 0 V_{CB} = 15 V
I_{CBO}(150°C)	Collector-Base Cutoff Current		15		15	µA	I_E = 0 V_{CB} = 15 V
I_{CEX}	Collector-Emitter Cutoff Current		15		15	µA	V_{CE} = 10 V V_{BE} = 0.25 V
I_{EBO}	Emitter Cutoff Current		100		100	µA	I_C = 0 V_{EB} = 3.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	25		25		Volts	I_E = 0 I_C = 100 µA
V_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	12		12		Volts	I_B = 0 I_C = 10 mA (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		3.0		Volts	I_C = 0 I_E = 100 µA
τ_s	Storage Time (Note 6)		25		35	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA
t_{on}	Turn On Time (Note 7)		40		40	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA, $I_{B2} \approx -1.0$ mA
t_{off}	Turn Off Time (Note 7)		75		75	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA, $I_{B2} \approx -1.0$ mA

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OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

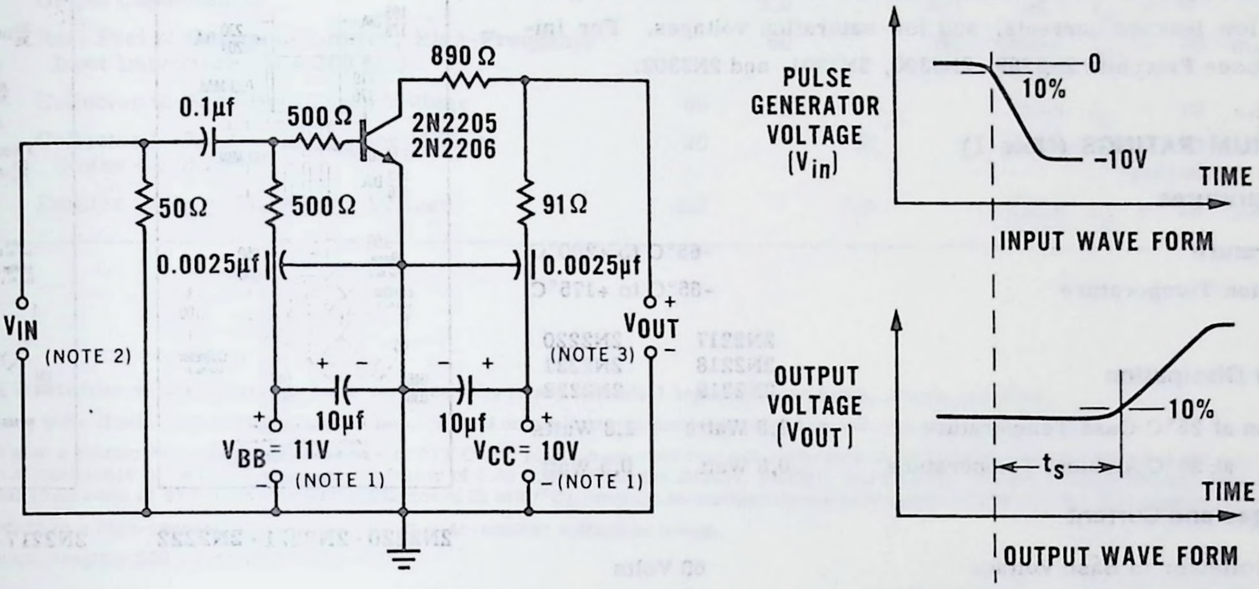
These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 150°C/Watt (derating factor of 6.7 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

Rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length < 6 msec; duty cycle <30%.

See Fig. 1 for exact value of I_C, I_{B1}, and I_{B2}.

See Fig. 2 for exact value of I_C, I_{B1}, and I_{B2}.


890 Ω
0.1µf
500 Ω
2N2205
2N2206
50Ω
500Ω
91Ω
0.0025µf
0.0025µf
V_IN
(NOTE 2)
+
V_OUT
(NOTE 3) −
+ −
− +
10µf
10µf
V_BB = 11V
(NOTE 1)
V_CC = 10V
− (NOTE 1)
PULSE GENERATOR VOLTAGE (V_in)
0
10%
−10V
TIME
INPUT WAVE FORM
OUTPUT VOLTAGE (V_OUT)
10%
t_s
TIME
OUTPUT WAVE FORM

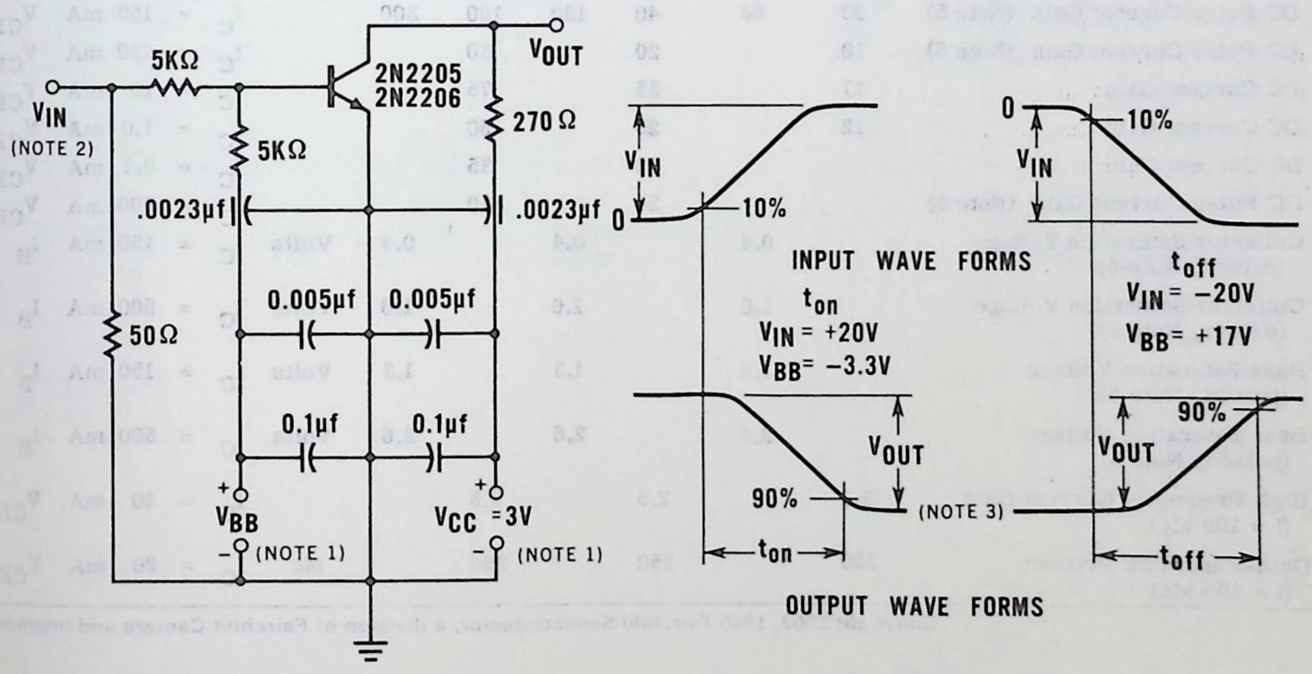
NOTES:

(1) With certain types of power supplies, it may be necessary to connect 25-µf decoupling capacitors across the power-supply terminals for V_{CC} and V_{BB}.

(2) Input voltage (V_{IN}) obtained from a pulse generator having an output impedance of 50 ohms. V_{IN} rise time <1 nsec; pulse duration >300 nsec, and duty factor <2%.

(3) Input and output waveforms, shown above, monitored by means of a sampling oscilloscope or other indicating device having rise time <0.5 nsec, input capacitance of probe <2.5 pf with shunt resistance > 1000 ohms.

FIG. 1. CIRCUIT USED TO MEASURE STORAGE TIME (t_s).


5KΩ
V_IN
(NOTE 2)
2N2205
2N2206
V_OUT
270 Ω
5KΩ
.0023µf
.0023µf
50Ω
0.005µf
0.005µf
0.1µf
0.1µf
+
V_BB
− (NOTE 1)
+
V_CC = 3V
− (NOTE 1)
V_IN
0
10%
INPUT WAVE FORMS
t_on
V_IN = +20V
V_BB = −3.3V
0
V_IN
10%
t_off
V_IN = −20V
V_BB = +17V
V_OUT
90%
t_on
(NOTE 3)
90%
V_OUT
t_off
OUTPUT WAVE FORMS

NOTES:

(1) With certain types of power supplies, it may be necessary to connect 25-µf decoupling capacitors across the power-supply terminals for V_{CC} and V_{BB}.

(2) Input voltage (V_{IN}) obtained from a pulse generator having an output impedance of 50 ohms. V_{IN} rise time <1 nsec; pulse duration >300 nsec, and duty factor <2%.

(3) Input and output waveforms, shown above, monitored by means of a sampling oscilloscope or other indicating device having rise time <0.5 nsec, input capacitance of probe <2.5 pf with shunt resistance >3000 ohms.

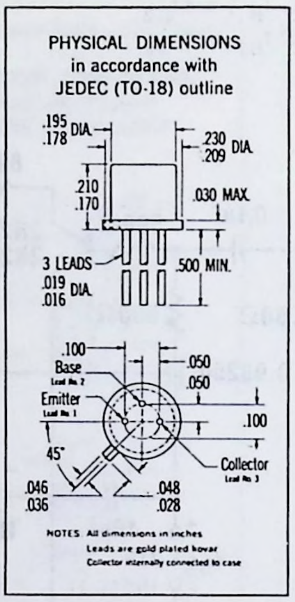
FIG. 2. CIRCUIT USED TO MEASURE "TURN-ON" TIME (t_{on}) AND "TURN-OFF" TIME (t_{off}).

2N2217 THROUGH 2N2222

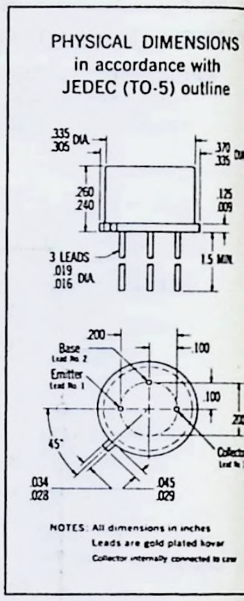
NPN HIGH-SPEED SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The Fairchild 2N2217 through 2N2222 are NPN Silicon Planar Epitaxial Transistors designed for high-speed switching at collector currents up to 500 milliamperes. They feature useful beta over a wide range of collector current, low leakage currents, and low saturation voltages. For improved performance see Fairchild 2N3299, 2N3300, 2N3301, and 2N3302.


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline
.195
.178 DIA.
.230
.209 DIA.
.210
.170
.030 MAX.
3 LEADS
.019
.016 DIA.
.500 MIN.
.100
Base
Lead No. 2
.050
.050
Emitter
Lead No. 1
.100
45°
Collector
Lead No. 3
.046
.036
.048
.028
NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2220 · 2N2221 · 2N2222


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline
.335
.305 DIA.
.370
.335
.260
.240
.125
.009
3 LEADS
.019
.016 DIA.
1.5 MIN.
.200
Base
Lead No. 2
.100
Emitter
Lead No. 1
.100
45°
.034
.028
.045
.029
NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2217 · 2N2218 · 2N2

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	-65°C to +175°C

Maximum Power Dissipation

	2N2217 2N2218 2N2219	2N2220 2N2221 2N2222
Total Dissipation at 25°C Case Temperature	3.0 Watts	1.8 Watts
at 25°C Ambient Temperature	0.8 Watt	0.5 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	800 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N2217 2N2220		2N2218 2N2221		2N2219 2N2222			
Symbol	Characteristics	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	20	60	40	120	100	300		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	10		20		50			I_C = 150 mA V_{CE} = 1.0 V
h_{FE}	DC Current Gain	17		35		75			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	12		25		50			I_C = 1.0 mA V_{CE} = 10 V
h_{FE}	DC Current Gain			20		35			I_C = 0.1 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)			20		30			I_C = 500 mA V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		0.4		0.4		0.4	Volts	I_C = 150 mA I_B = 15 m
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		1.6		1.6		1.6	Volts	I_C = 500 mA I_B = 50 m
V_{BE}(sat)	Base Saturation Voltage (pulsed, Note 5)		1.3		1.3		1.3	Volts	I_C = 150 mA I_B = 15 m
V_{BE}(sat)	Base Saturation Voltage (pulsed, Note 5)		2.6		2.6		2.6	Volts	I_C = 500 mA I_B = 50 m
h_{fe}	High Frequency Current Gain (f = 100 Mc)	2.5		2.5		2.5			I_C = 20 mA V_{CE} = 20 V
f_T	Gain-Bandwidth Product (f = 100 Mc)	250		250		250		Mc	I_C = 20 mA V_{CE} = 20 V

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS 2N2217 THROUGH 2N2222

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics	2N2217 2N2220 2N2218 2N2221 Min.	Max.	2N2219 2N2222 Min.	Max.	Units	Test Conditions
I_{CBO}	Collector Cutoff Current		10		10	nA	$I_E = 0$ $V_{CB} = 50$ V
I_{CBO}(150°C)	Collector Cutoff Current		10		10	μA	$I_E = 0$ $V_{CB} = 50$ V
I_{EBO}	Emitter Cutoff Current		10		10	nA	$I_C = 0$ $V_{EB} = 3.0$ V
C_{obo}	Output Capacitance		8.0		8.0	pf	$I_E = 0$ $V_{CB} = 10$ V
$R_{e(hie)}$	Real Part of Common-Emitter, High-Frequency Input Impedance (f = 300 Mc)		60		60	Ohms	$I_C = 20$ mA $V_{CE} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		Volts	$I_C = 10$ μA $I_E = 0$
V_{CEO}	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30		30		Volts	$I_C = 10$ mA (pulsed) $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		Volts	$I_E = 10$ μA $I_C = 0$

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C); junction-to-ambient thermal resistance of 188°C/Watt (derating factor of 5.33 mW/°C) for the 2N2217, 2N2218, and 2N2219. For the 2N2220, 2N2221, and 2N2222 junction-to-case thermal resistance of 83.5°C/Watt (derating factor of 12 mW/°C); junction-to-ambient thermal resistance of 300°C/Watt (derating factor of 3.33 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle ≤ 2%.

2N2218A · 2N2219A · 2N2221A · 2N2222A

NPN HIGH SPEED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - These Fairchild devices are NPN silicon PLANAR epitaxial transistors designed for high-speed switching at collector currents up to 500 mA. They feature useful beta over a wide range of collector current, low leakage currents, and low saturation voltages.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+175°C Maximum

Maximum Power Dissipation

		2N2218A 2N2219A	2N2221A 2N2222A
Total Dissipation at 25°C Case Temperature	(Notes 2 & 3)	3.0 Watts	1.8 Watt
at 25°C Ambient Temperature	(Notes 2 & 3)	0.8 Watt	0.5 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		75 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage		6.0 Volts
I_C	Collector Current		800 mA

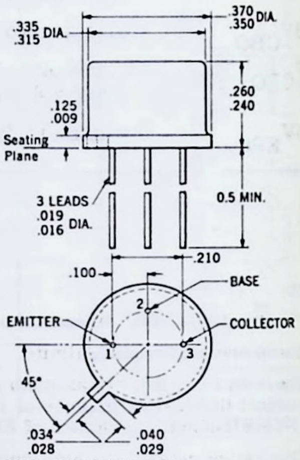
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N2218A 2N2221A Min.	2N2218A 2N2221A Max.	2N2219A 2N2222A Min.	2N2219A 2N2222A Max.	Units	Test Conditions
h_{FE}	DC Current Gain	20		35			I_C = 100 μA V_{CE} = 10 V
h_{FE}	DC Current Gain	25		50			I_C = 1.0 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	35		75			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	100	300		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	25		40			I_C = 500 mA V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	15		35			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20		50			I_C = 150 mA V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, Note 5)		0.3		0.3	Volts	I_C = 150 mA I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, Note 5)		1.0		1.0	Volts	I_C = 500 mA I_B = 50 mA
V_{BE}(sat)	Base Saturation Voltage (Pulsed, Note 5)	0.6	1.2	0.6	1.2	Volts	I_C = 150 mA I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage (Pulsed, Note 5)		2.0		2.0	Volts	I_C = 500 mA I_B = 50 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5		3.0			I_C = 20 mA V_{CE} = 20 V
f_T	Gain-Bandwidth Product (f = 100 MHz)	250		300		MHz	I_C = 20 mA V_{CE} = 20 V

*Planar is a patented Fairchild process.

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-5) outline

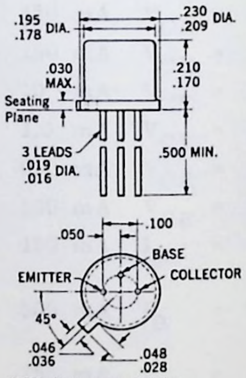


NOTES: All dimensions in inches
Leads are gold-plated Kovar
Lead No. 3 internally connected to case
Package weight is 1.23 grams

2N2218A ∘ 2N2219A

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar*
Lead No. 3 internally connected to case
Package weight is 0.44 gram

2N2221A ∘ 2N2222A

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FAIRCHILD TRANSISTORS 2N2218A • 2N2219A • 2N2221A • 2N2222A

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N2218A 2N2221A MIN.	 MAX.	2N2219A 2N2222A MIN.	 MAX.	UNITS	TEST CONDITIONS
I_{CEX}	Collector Reverse Current		10		10	nA	V_{EB} = 3.0 V V_{CE} = 60 V
I_{CBO}	Collector Reverse Current		10		10	nA	I_E = 0 V_{CB} = 60 V
I_{CBO}(+150°C)	Collector Reverse Current		10		10	μA	I_E = 0 V_{CB} = 60 V
I_{EBO}	Base Current		10		10	nA	I_C = 0 V_{EB} = 3.0 V
C_{obo}	Common Base, Open Circuit Output Capacitance (f = 100 kHz)		8.0		8.0	pF	I_E = 0 V_{CB} = 10 V
C_{ibo}	Common Base, Open Circuit Input Capacitance (f = 100 kHz)		25		25	pF	I_C = 0 V_{EB} = 0.5 V
Re(h_{ie})	Real Part of Common-Emitter High Frequency Input Impedance (f = 300 MHz)		60		60	Ohms	I_C = 20 mA V_{CE} = 20 V
BV_{CBO}	Collector to Base Breakdown Voltage	75		75		Volts	I_C = 10 μA I_E = 0
BV_{CEO}	Collector to Emitter Breakdown Voltage (Notes 4 & 5)	40		40		Volts	I_C = 10 mA I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	I_C = 0 I_E = 10 μA
I_{BL}	Base Current		20		20	nA	V_{EB} = 3.0 V V_{CE} = 60 V
t_d	Turn-on Delay Time		10		10	ns	I_{CS} = 150 mA V_{CC} = 30 V I_{B1} = 15 mA, V_{BE}(off) = 0.5 V
t_r	Rise Time		25		25	ns	I_{CS} = 150 mA V_{CC} = 30 V I_{B1} = 15 mA, V_{BE}(off) = 0.5 V
t_s	Storage Time		225		225	ns	I_{CS} = 150 mA V_{CC} = 30 V I_{B1} = 15 mA, I_{B2} = 15 mA
t_f	Fall Time		60		60	ns	I_{CS} = 150 mA V_{CC} = 30 V I_{B1} = 15 mA, I_{B2} = 15 mA
τ_A	Active Region Time Constant		2.5		2.5	ns	I_C = 150 mA V_{CE} = 30 V
$r_b'C_c$	Collector Base Time Constant (f = 31.8 MHz)		150		150	ps	I_C = 20 mA V_{CE} = 20 V
NF	Noise Figure (f = 1.0 kHz)		4.0		4.0		I_C = 100 μA V_{CE} = 10 V R_g = 1.0 kΩ BW = 1.0 Hz

SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

SYMBOL	CHARACTERISTIC	2N2218A 2N2221A MIN.	 MAX.	2N2219A 2N2222A MIN.	 MAX.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	1.0	3.5	2.0	8.0	kΩ	I_C = 1.0 mA V_{CB} = 10 V
		0.2	1.0	0.25	1.25	kΩ	I_C = 10 mA V_{CB} = 10 V
h_{oe}	Output Conductance	3.0	15	5.0	35	μmhos	I_C = 1.0 mA V_{CB} = 10 V
		10	100	25	200	μmhos	I_C = 10 mA V_{CB} = 10 V
h_{re}	Voltage Feedback Ratio		500		800	x10^{-6}	I_C = 1.0 mA V_{CB} = 10 V
			250		400	x10^{-6}	I_C = 10 mA V_{CB} = 10 V
h_{fe}	Forward Current Transfer Ratio	30	150	50	300		I_C = 1.0 mA V_{CB} = 10 V
		50	300	75	375		I_C = 10 mA V_{CB} = 10 V

NOTES:

) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C); junction-to-ambient thermal resistance of 188°C/Watt (derating factor of 5.33 mW/°C) for the 2N2218A and 2N2219A. For the 2N2221A and 2N2222A, junction-to-case thermal resistance of 83.5°C/Watt (derating factor of 12 mW/°C; junction-to-ambient thermal resistance of 300°C/Watt (derating factor of 3.33 mW/°C).

) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

) Pulse Conditions: length = 300 μs ; duty cycle = 1%.

2N2297

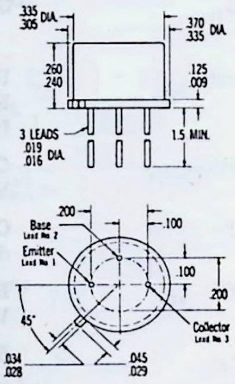
NPN HIGH-CURRENT GENERAL PURPOSE TYPE

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

The 2N2297 is an NPN double-diffused silicon PLANAR epitaxial transistor with very low saturation resistance, high current capabilities, typical gain-bandwidth product of 90 megacycles, low C_{ob} and low leakage currents.

This transistor is designed for use in high-performance dc-dc converters, oscillators, high current memory drivers and computer clock distribution circuits. The 2N2297 is suitable in particular for output stages of servo amplifiers and transceivers where several watts output at high efficiency is required.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, no time limit	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	5.0 Watts
at 100°C Case Temperature [Notes 2 and 3]	2.8 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.8 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	80 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	35 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	**40**	**55**	**120**		$I_C = 150$ mA	$V_{CE} = 10$ V
V_{CE} (sat)	Collector Saturation Voltage		**0.15**	**0.2**	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE} (sat)	Collector Saturation Voltage [Note 6]		**0.8**	**1.0**	Volts	$I_C = 1000$ mA	$I_B = 100$ mA
V_{BE} (sat)	Base Saturation Voltage		**1.4**	**1.6**	Volts	$I_C = 1000$ mA	$I_B = 100$ mA
I_{CBO}	Collector Cutoff Current		**0.1**	**10**	nA	$I_E = 0$	$V_{CB} = 60$ V
I_{EBO}	Emitter Cutoff Current			**10**	nA	$I_C = 0$	$V_{EB} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	**80**			Volts	$I_E = 0$	$I_C = 100\ \mu A$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	**35**			Volts	$I_B = 0$	$I_C = 30$ mA (pulsed)

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NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on aplications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/watt (derating factor of 28.6 mW/°C); junction-to-ambient thermal resistance of 218°C/watt (derating factor of 4.6 mW/°C).
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle ≤1%.
(6) Measured at a point on the leads ≤ ½ inch from the seating plane of transitor case.

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	50			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	15	30			$I_C = 1.0$ A	$V_{CE} = 10$ V
I_{CBO} (150°C)	Collector Cutoff Current		0.2	10	μA	$V_{CB} = 60$ V	$I_E = 0$
f_T	Gain Bandwidth Product (f = 20 mc)	60	95		mc	$I_C = 50$ mA	$V_{CE} = 10$ V
C_{ob}	Output Capacitance		8.0	12	pf	$V_{CB} = 10$ V	$I_E = 0$
C_{TE}	Emitter Transition Capacitance		53	80	pf	$V_{EB} = 0.5$ V	$I_C = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			Volts	$I_E = 100$ μA	$I_C = 0$
$r_b'C_c$	Collector to Base Time Constant (f = 4 mc)			800	psec	$I_C = 10$ mA	$V_{CB} = 10$ V

2N2616 • 2N2729

NPN ULTRA-HIGH FREQUENCY OSCILLATOR AND AMPLIFIER TYPE

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The 2N2616 and 2N2729 are NPN Double-Diffused Silicon Planar Epitaxial Transistors. They are designed for low-noise, high-frequency amplifiers; 1 GHz local oscillators; non-neutralized IF amplifiers and non-saturating circuits with rise and fall times of less than 2.5 nanoseconds.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, No Time Limit)	+300°C Maximum

Maximum Power Dissipation

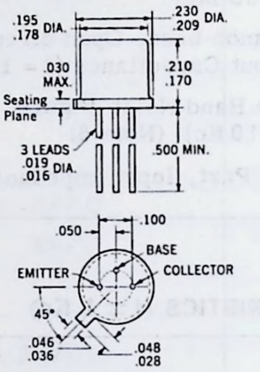
Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.8 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.3 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA

PHYSICAL DIMENSIONS

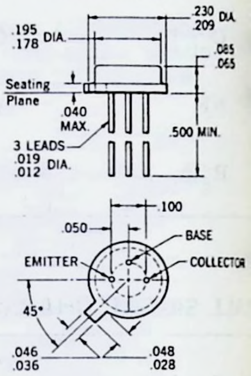
in accordance with JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar*
Lead No. 3 internally connected to case
Package weight is 0.44 gram

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Lead No. 3 internally connected to case
Package weight is 0.34 gram

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Current Gain	20	50			I_C = 3.0 mA V_{CE} = 1.0 V
V_{BE}(sat)	Pulsed Base-Emitter Saturation Voltage (Note 6)			1.0	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Pulsed Collector-Emitter Saturation Voltage (Note 6)			0.4	Volts	I_C = 10 mA I_B = 1.0 mA
C_{obo}	Output Capacitance		2.4	2.8	pF	I_E = 0 V_{CB} = 10 V
C_{ibo}	Input Capacitance			2.0	pF	I_C = 0 V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current			10	nA	I_E = 0 V_{CB} = 15 V
I_{CBO}(150°C)	Collector Cutoff Current			1.0	μA	I_E = 0 V_{CB} = 15 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	6.0	9.0			I_C = 4.0 mA V_{CE} = 10 V
A_p	Available Power Gain (neutralized) (f = 200 MHz)	15	18		dB	I_C = 6.0 mA V_{CE} = 12 V
P_o	Power Output (f = 500 MHz)	30	45		mW	I_C = 8.0 mA V_{CE} = 15 V
	Collector Efficiency (f = 500 MHz)	25			%	I_C = 8.0 mA V_{CE} = 15 V
NF	Noise Figure (Note 5)			6.0	dB	I_C = 1.0 mA V_{CE} = 6.0 V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 4)	15			Volts	I_C = 3.0 mA I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	I_C = 1.0 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_C = 0 I_E = 10 μA

* Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) f = 60 MHz, R_G = 400Ω.

(6) Pulse Conditions: length = 300μs; duty cycle ≤ 1%

2N2695 • 2N2696 • 2N2927

PNP VHF AMPLIFIERS, HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

e 2N2695, 2N2696, and 2N2927 are PNP silicon PLANAR epitaxial transistors designed for digital and analog plications at current levels to 500 milliamperes. The high gain-bandwidth product, f_T, at high currents, makes em excellent units for line driving and memory applications.

BSOLUTE MAXIMUM RATINGS [Note 1]

aximum Temperatures	2N2695	2N2696	2N2927
Storage Temperature	−65°C to +200°C	−65°C to +200°C	−65°C to +200°C
Operating Junction Temperature	200°C Maximum	200°C Maximum	200°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	300°C Maximum	300°C Maximum	300°C Maximum
aximum Power Dissipation			
Total Dissipation at 25°C Case Temperature [Note 2 and 3]	2.0 Watts	1.2 Watts	3.0 Watts
at 100°C Case Temperature [Note 2 and 3]	1.0 Watt	0.68 Watt	1.7 Watts
at 25°C Ambient Temperature [Note 2 & 3]	0.36 Watt	0.36 Watt	0.8 Watt
aximum Voltages			
V_{CBO} Collector to Base Voltage	−25 Volts	−25 Volts	−25 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	−25 Volts	−25 Volts	−25 Volts
V_{EBO} Emitter to Base Voltage	−4.0 Volts	−4.0 Volts	−4.0 Volts
I_C Collector Current [Note 2]	500 mA	500 mA	500 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
$_{FE}$	DC Pulse Current Gain [Note 5]	30	130		$I_C = 50$ mA $V_{CE} = -1.0$ V
$_{FE}$	DC Pulse Current Gain [Note 5]	20			$I_C = 300$ mA $V_{CE} = -2.0$ V
$_{FE}$ (−55°C)	DC Pulse Current Gain [Note 5]	12			$I_C = 50$ mA $V_{CE} = -1.0$ V
$_{BE}$ (sat)	Base Saturation Voltage		−1.1	Volts	$I_C = 50$ mA $I_B = 2.5$ mA
$_{BE}$ (sat)	Base Saturation Voltage		−2.0	Volts	$I_C = 300$ mA $I_B = 30$ mA
$_{CE}$ (sat)	Collector Saturation Voltage		−0.25	Volts	$I_C = 50$ mA $I_B = 2.5$ mA
$_{CE}$ (sat)	Collector Saturation Voltage		−1.0	Volts	$I_C = 300$ mA $I_B = 30$ mA
$_{fe}$	High Frequency Current Gain (f = 100 mc)	1.0			$I_C = 50$ mA $V_{CE} = -3.0$ V
$_{ob}$	Output Capacitance		20	pf	$I_E = 0$ $V_{CB} = -10$ V
$_{CBO}$	Collector Cutoff Current		25	nA	$I_E = 0$ $V_{CB} = -10$ V
$_{CBO}$ (150°C)	Collector Cutoff Current		5.0	μA	$I_E = 0$ $V_{CB} = -10$ V
V_{CBO}	Collector to Base Breakdown Voltage	−25		Volts	$I_C = 100\ \mu A$ $I_E = 0$
$_{CEO}$ (sust)	Collector to Emitter Sustaining Voltage [Note 4 & 5]	−25		Volts	$I_C = 30$ mA $I_B = 0$ (pulsed)
V_{EBO}	Emitter to Base Breakdown Voltage	−4.0		Volts	$I_C = 0$ $I_E = 100\ \mu A$
$_{on}$	Turn On Time [Note 6]		75	nsec	$I_C \approx 300$ mA $I_{B1} \approx 30$ mA
$_{off}$	Turn Off Time [Note 6]		170	nsec	$I_C \approx 300$ mA $I_{B1} \approx 30$ mA $I_{B2} \approx -30$ mA

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OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

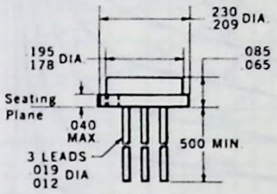
These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 87.5°C/watt (derating factor of 11.4 mW/°C) for the 2N2695; for the 2N2696 146°C/watt (derating factor of 6.9 mW/°C); for the 2N2927 58.3°C/watt (derating factor of 17.2 mW/°C). Junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.1 mW/°C) for the 2N2695 and 2N2696; for the 2N2927 219°C/watt (derating factor of 4.56 mW/°C).

Rating refers to a high current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μsec; duty cycle = 1%.

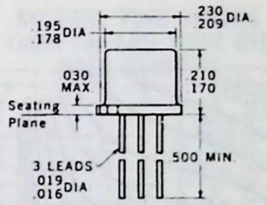
See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline

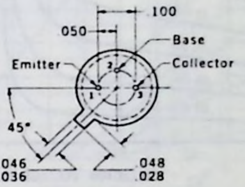


2N2695

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



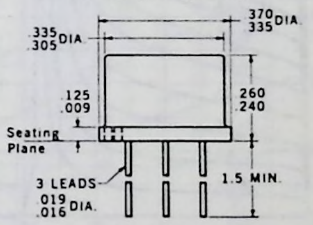
2N2696

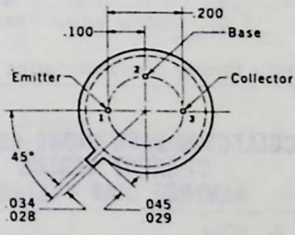


NOTES. All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2695 2N2696

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline





NOTES. All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2927

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

NOTES:

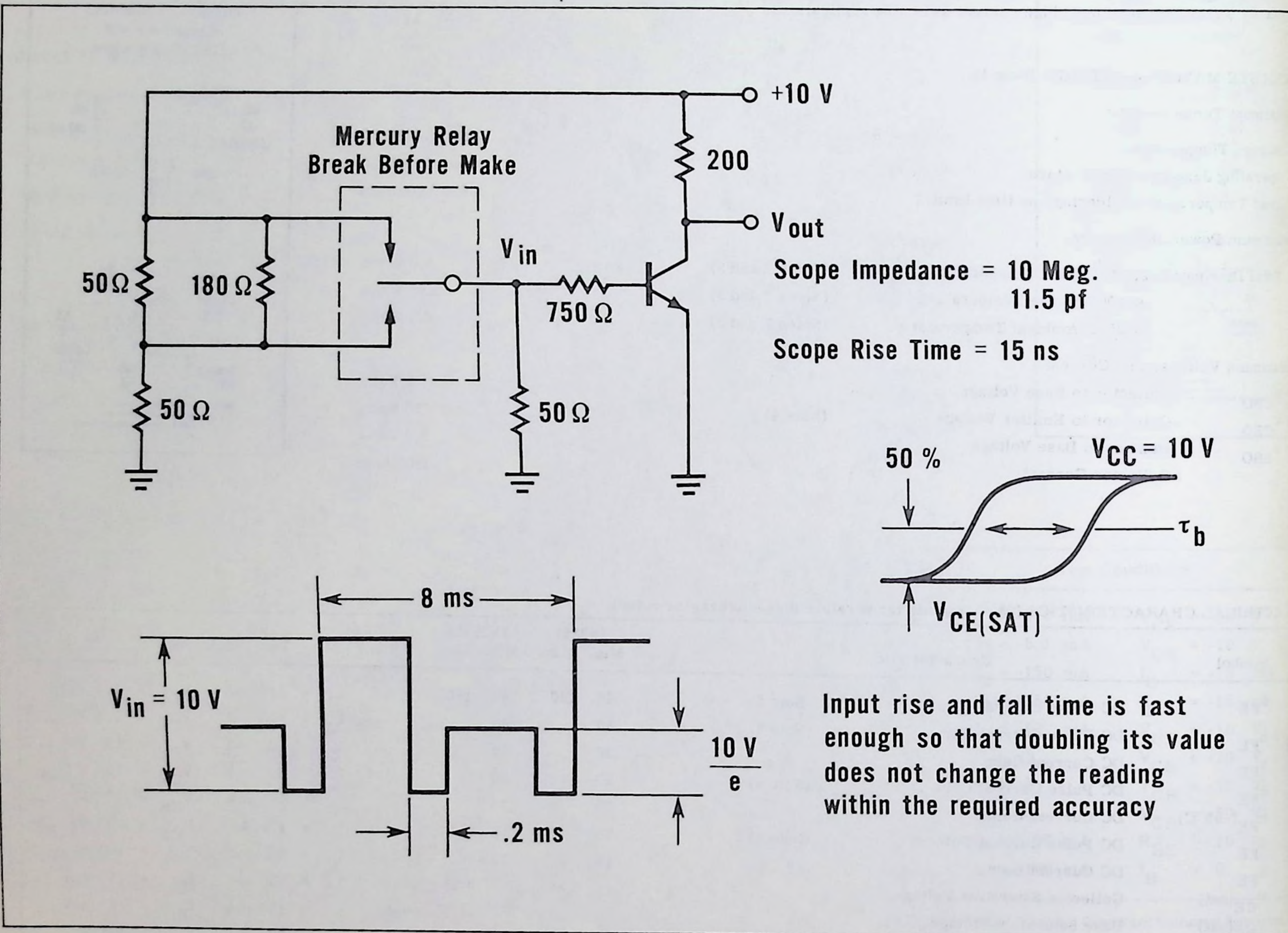
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/Watt (derating factor of 28.5 mW/°C); junction-to-ambient thermal resistance of 438°C/Watt (derating factor of 2.3 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length ≤ 300 μsec; duty cycle ≤ 2%.


+10 V
Mercury Relay
Break Before Make
200
V out
V in
50Ω
180 Ω
750 Ω
50 Ω
50 Ω
50 %
VCC = 10 V
τb
VCE(SAT)
8 ms
Vin = 10 V
10 V
e
.2 ms

Scope Impedance = 10 Meg.
11.5 pf

Scope Rise Time = 15 ns

Input rise and fall time is fast enough so that doubling its value does not change the reading within the required accuracy

FIGURE 1

2N2368 • 2N2369

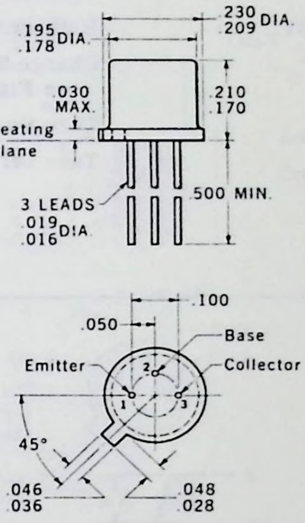
NPN HIGH FREQUENCY SATURATED SWITCHING TYPE

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The 2N2368 and 2N2369 are NPN silicon Planar epitaxial transistors designed specifically for high-speed saturated switching applications in the 50-100 MHz range at current levels from 100 microamps to 100 milliamps. They are suitable for most satellite and conventional, small signal, RF and digital type circuits.

A typical gain bandwidth product of 650 MHz, typical τ_s of 6 ns and C_{obo} of 4 pF maximum along with Planar structure give high performance and proven reliability.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.2 Watts
at 100°C Case Temperature	(Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		40 Volts
V_{CES}	Collector to Emitter Voltage		40 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage		4.5 Volts
I_C	Collector Current (10 μsec pulse)		500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N2368 Min.	2N2368 Typ.	2N2368 Max.	2N2369 Min.	2N2369 Typ.	2N2369 Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	20		60	40		120		I_C = 10 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	10			20				I_C = 100 mA V_{CE} = 2.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	10			20				I_C = 10 mA V_{CE} = 1.0 V
V_{BE}(sat)	Base Saturation Voltage	0.7	0.75	0.85	0.7	0.75	0.85	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.2	0.25		0.2	0.25	Volts	I_C = 10 mA I_B = 1.0 mA

Additional Electrical Characteristics on page 2

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions; length = 300 μsec; duty cycle $\leq$ 2%.

(6) Measured on Sampling Scope. PW $\geq$ 200 nsec.

* Planar is a patented Fairchild process.

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N2368 Min.	2N2368 Typ.	2N2368 Max.	2N2369 Min.	2N2369 Typ.	2N2369 Max.	Units	Test Conditions
h_{fe}	High Frequency Current Gain (f=100 MHz)	4.0	5.5		5.0	6.5			I_C = 10 mA V_{CE} = 10 V
C_{obo}	Open Circuit Output Capacitance		2.5	4.0		2.5	4.0	pF	I_E = 0 V_{CB} = 5.0 V
I_{CBO}	Collector Cutoff Current		0.1	0.4		0.1	0.4	μA	I_E = 0 V_{CB} = 20 V
I_{CBO}(150°C)	Collector Cutoff Current		10	30		10	30	μA	I_E = 0 V_{CB} = 20 V
BV_{CBO}	Collector to Base Breakdown Voltage	40			40				I_C = 10 μA I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	40			40			Volts	I_C = 10 μA I_B = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			15			Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			4.5			Volts	I_C = 0 I_E = 10 μA
τ_s	Charge Storage Time Constant (Note 6) (see Figure 1)		5.0	10		6.0	13	nsec	$I_C = I_{B1}$ ≈ 10 mA, I_{B2} ≈ -10 mA
t_{on}	Turn On Time (see Figure 2)		9.0	12		9.0	12	nsec	I_C ≈ 10 mA, I_{B1} ≈ 3.0 mA
t_{off}	Turn Off Time (see Figure 2)		10	15		13	18	nsec	I_C ≈ 10 mA, I_{B1} ≈ 3.0 mA, I_{B2} ≈ -1.5 mA

FIG. 1

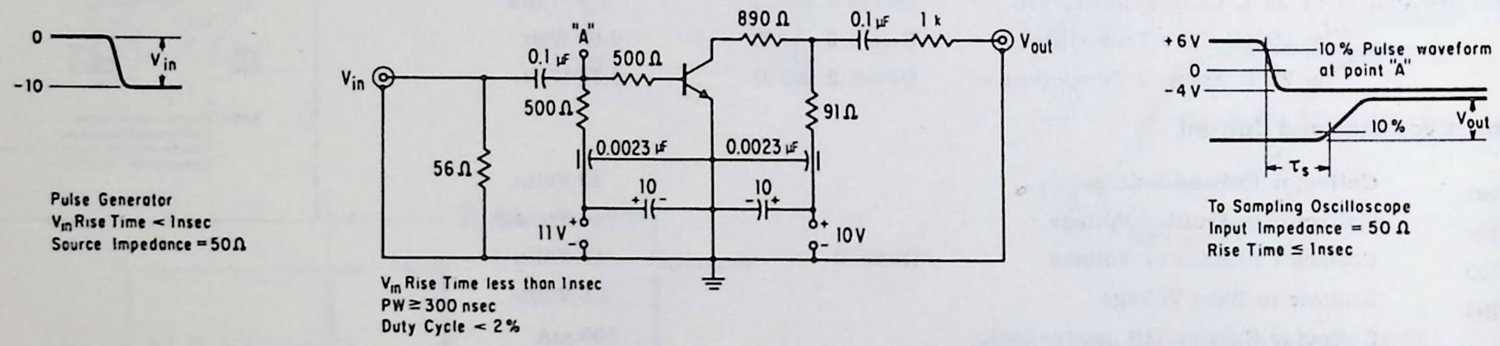
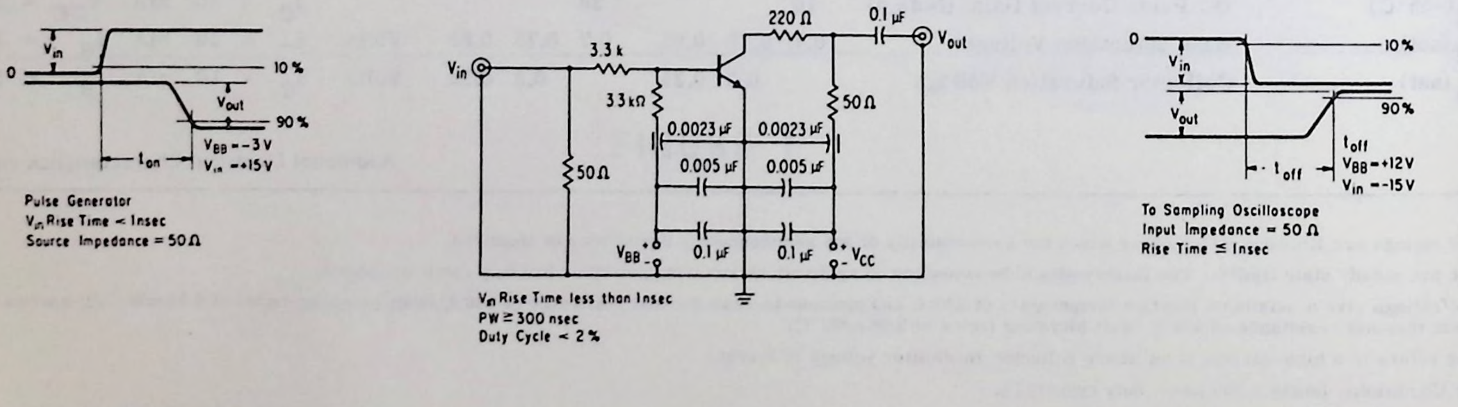

0
-10
Vin
Pulse Generator
Vin Rise Time < 1nsec
Source Impedance = 50Ω
Vin
"A"
0.1 μF
500Ω
500Ω
56Ω
890 Ω
0.1 μF
1 k
Vout
91Ω
0.0023 μF
0.0023 μF
10
10
11V
10V
Vin Rise Time less than 1nsec
PW ≥ 300 nsec
Duty Cycle < 2%
+6V
0
-4V
10% Pulse waveform at point "A"
10%
Vout
τs
To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1nsec

FIG. 2


Vin
0
10%
Vout
90%
VBB = -3V
Vin = +15V
ton
Pulse Generator
Vin Rise Time < 1nsec
Source Impedance = 50Ω
Vin
3.3 k
3.3 kΩ
50Ω
220 Ω
0.1 μF
Vout
50Ω
0.0023 μF
0.0023 μF
0.005 μF
0.005 μF
0.1 μF
0.1 μF
VBB
VCC
Vin Rise Time less than 1nsec
PW ≥ 300 nsec
Duty Cycle < 2%
0
10%
Vin
Vout
90%
toff
toff
VBB = +12V
Vin = -15V
To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1nsec

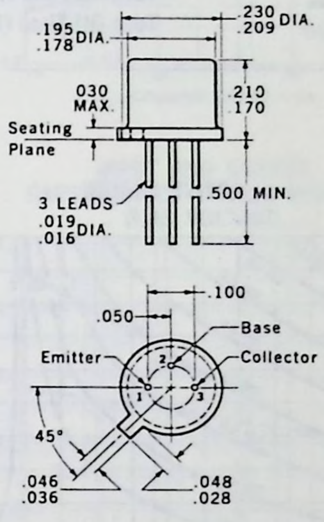
2N2369A

NPN HIGH-SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- HIGH SPEED - - $\tau_S = 13$ ns (MAX) AT 10 mA
  - - - $t_{on} = 12$ ns (MAX) AT 10 mA
  - - - $t_{off} = 18$ ns (MAX) AT 10 mA
- MEDIUM VOLTAGE - - $LV_{CEO} = 15$ V (MIN)
- HIGH FREQUENCY - - $f_T = 500$ MHz (MIN) AT 10 mA
- LOW CAPACITANCE - - $C_{obo} = 4.0$ pF (MAX) AT 5.0 V

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.44 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.2 Watts
at 100°C Case Temperature	0.68 Watt
at 25°C Ambient Temperature	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts
I_C	Collector Current (10 μs Pulse)	500 mA
I_C	DC Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	66	120		$I_C = 10$ mA	$V_{CE} = 1.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	20	50			$I_C = 10$ mA	$V_{CE} = 0.35$ V
$V_{BE(sat)}$	Base Saturation Voltage	0.72	0.8	0.85	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage (−55°C to +125°C)	0.59		1.02	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		0.9	1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		1.1	1.6	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (+125°C)		0.19	0.3	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
I_{CES}	Collector Reverse Current		0.05	0.4	μA	$V_{BE} = 0$	$V_{CE} = 20$ V
$I_{CBO}(+150°C)$	Collector Cutoff Current		10	30	μA	$I_E = 0$	$V_{CB} = 20$ V
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	$I_C = 10$ μA	$I_E = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**15**			**Volts**	**$I_C = 10$ mA (pulsed)**	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			Volts	$I_E = 10$ μA	$I_C = 0$

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C). Junction to ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).

(4) Rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.

(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTOR 2N2369A

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

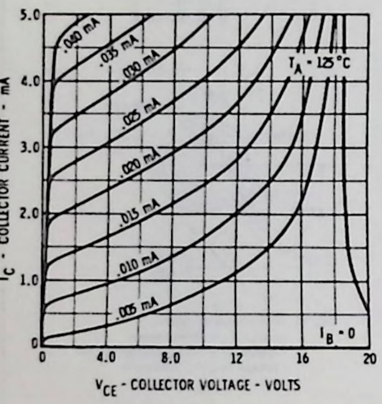
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	63	120		$I_C = 10$ mA	$V_{CE} = 0.35$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	71			$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20				$I_C = 100$ mA	$V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage		0.14	0.2	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.17	0.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.28	0.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**5.0**	**6.75**			$I_C = 10$ mA	$V_{CE} = 10$ V
C_{obo}	**Output Capacitance**		**2.3**	**4.0**	pF	$I_E = 0$	$V_{CB} = 5.0$ V
τ_S	**Charge Storage Time Constant (Note 6)**		**6.0**	**13**	ns	$I_C = I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA	
t_{on}	**Turn On Time (Note 6)**		**9.0**	**12**	ns	$I_C \approx 10$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	**Turn Off Time (Note 6)**		**13**	**18**	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA, $I_{B2} \approx -1.5$ mA	

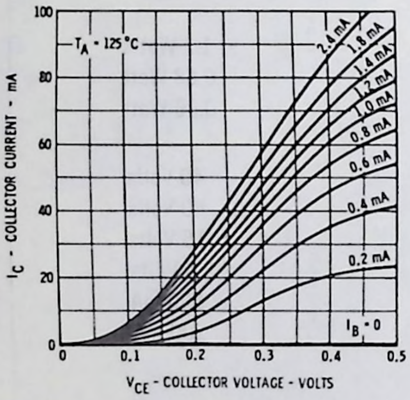
TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

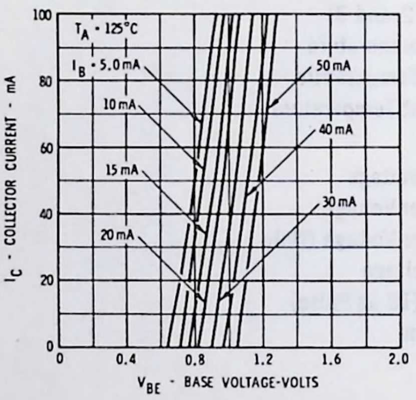
ACTIVE REGION

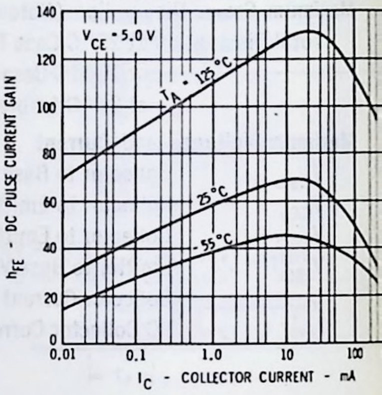
SATURATION REGION

D.C. PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

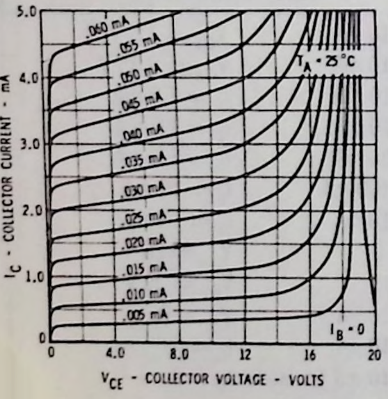


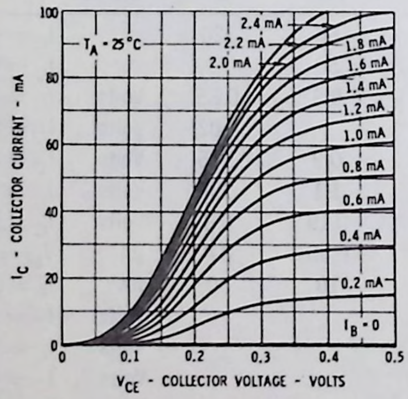


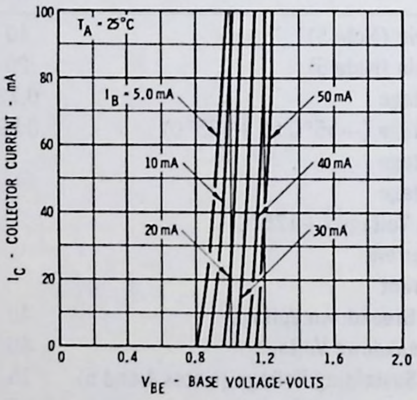


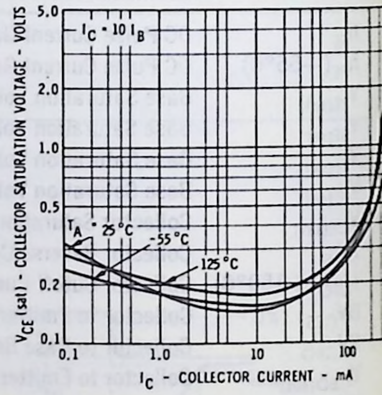


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

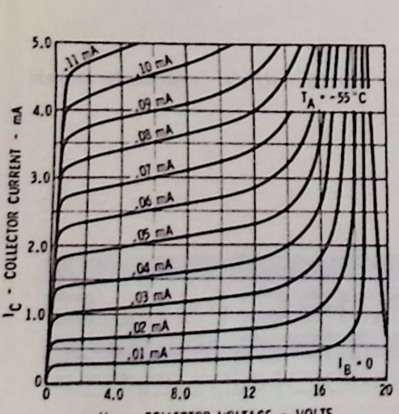


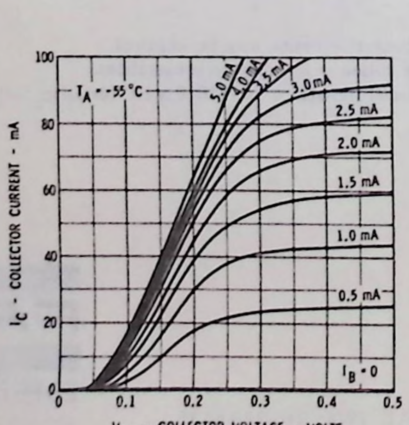


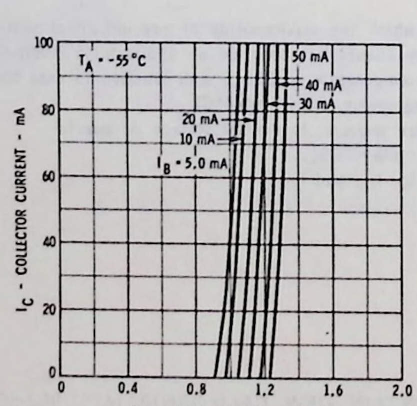


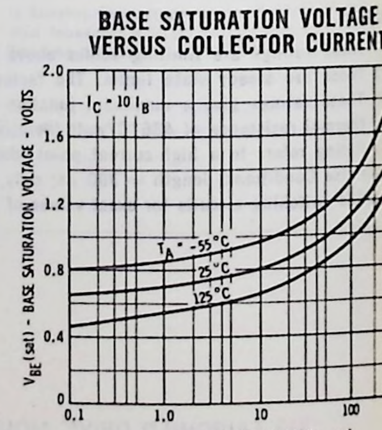


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT





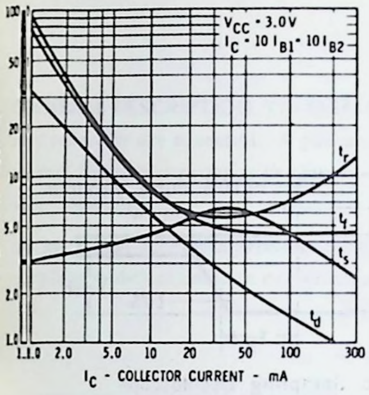




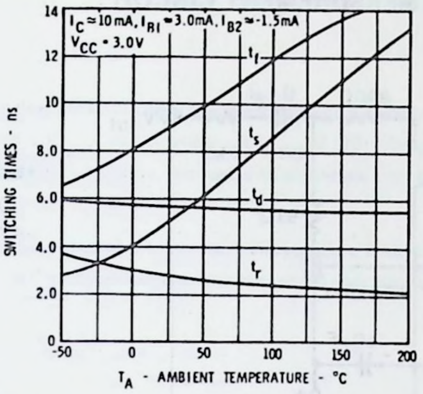
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

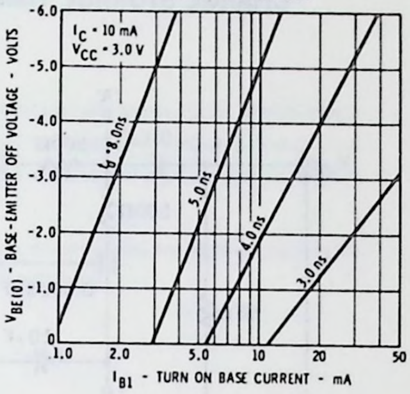
SWITCHING TIMES VERSUS COLLECTOR CURRENT



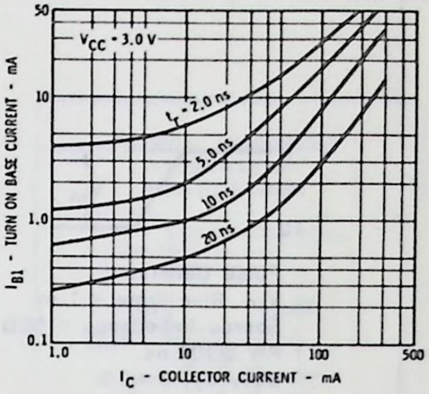
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



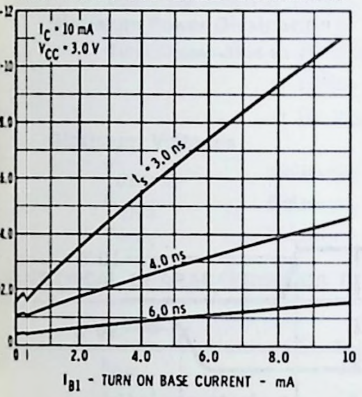
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



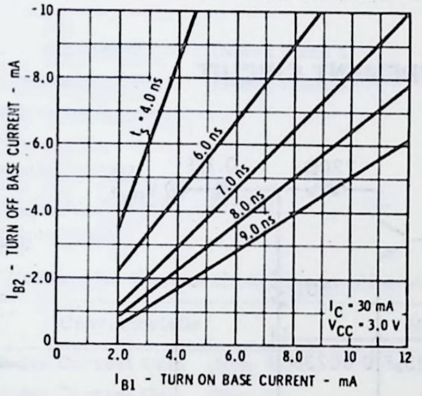
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



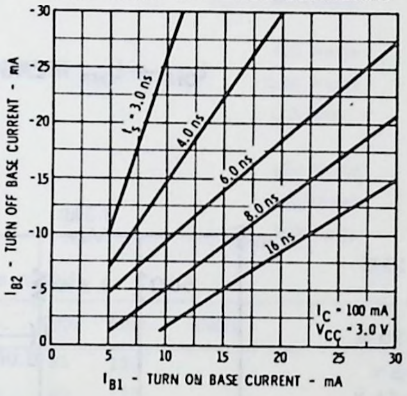
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



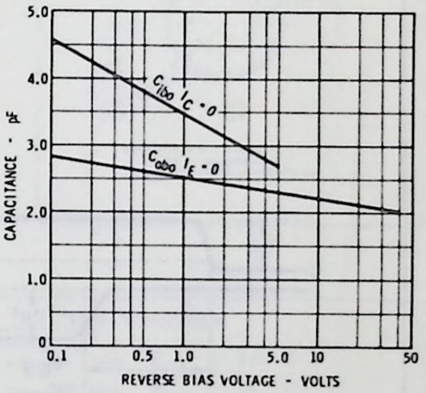
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



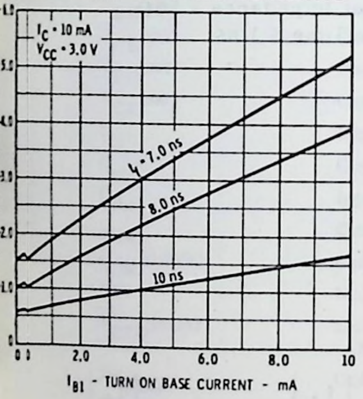
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



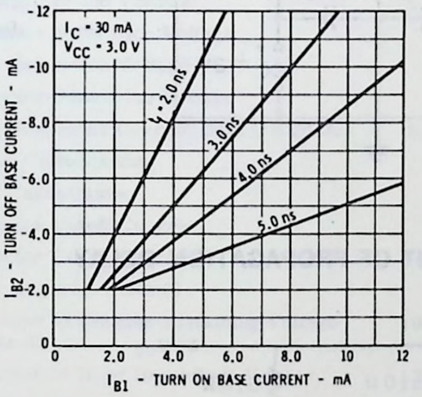
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



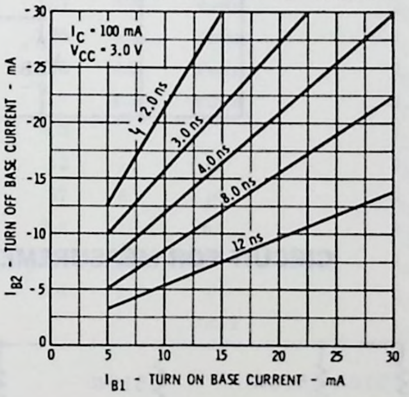
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



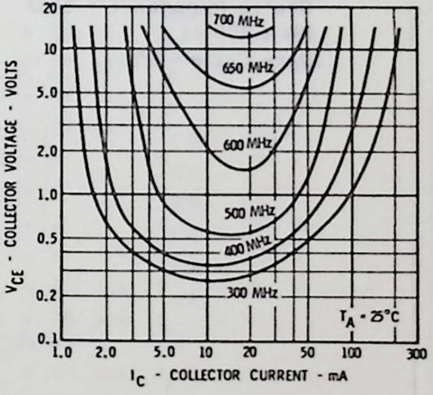
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



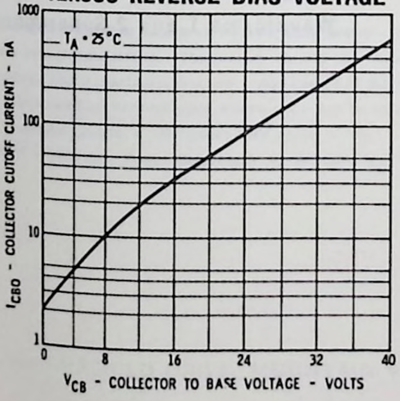
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



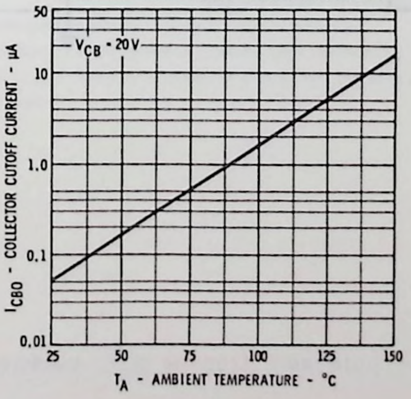
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



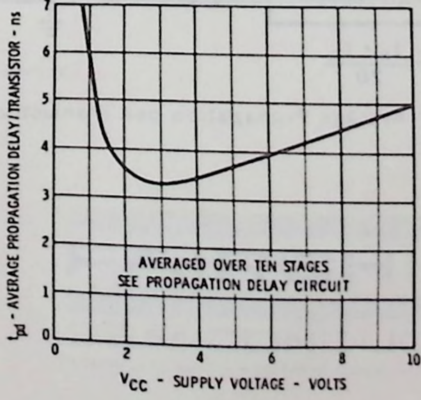
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



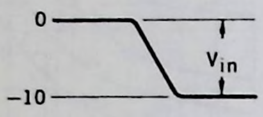
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



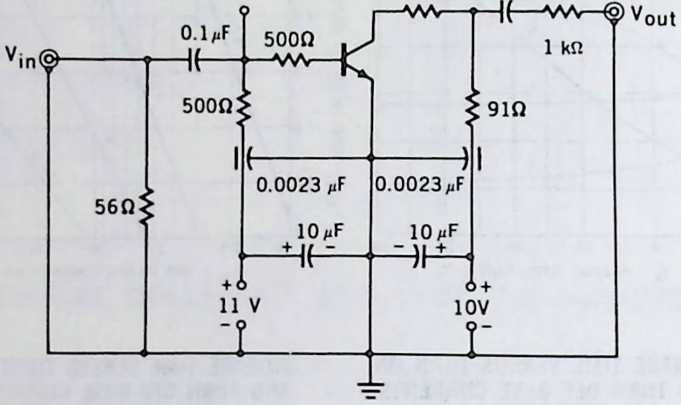
AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

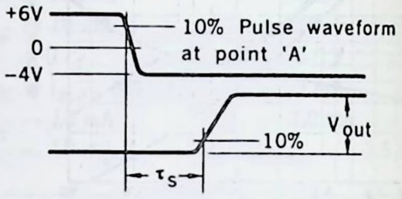


CHARGE STORAGE TIME MEASUREMENT CIRCUIT



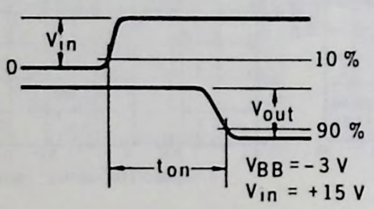
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %


V_{in}
'A'
0.1 μF
500Ω
890Ω
0.1 μF
V_{out}
1 kΩ
500Ω
91Ω
56Ω
0.0023 μF
0.0023 μF
10 μF
10 μF
+
−
+
−
+
11 V
−
+
10V
−

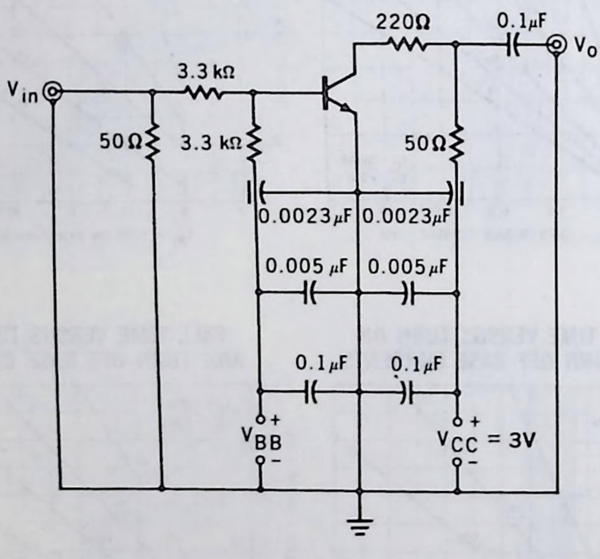

+6V
0
−4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_S

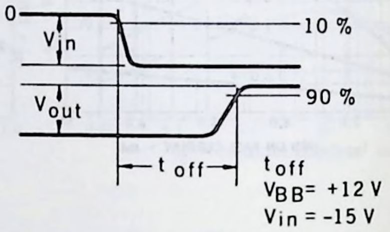
To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT


V_{in}
0
10 %
V_{out}
90 %
t_{on}
$V_{BB} = -3$ V
$V_{in} = +15$ V

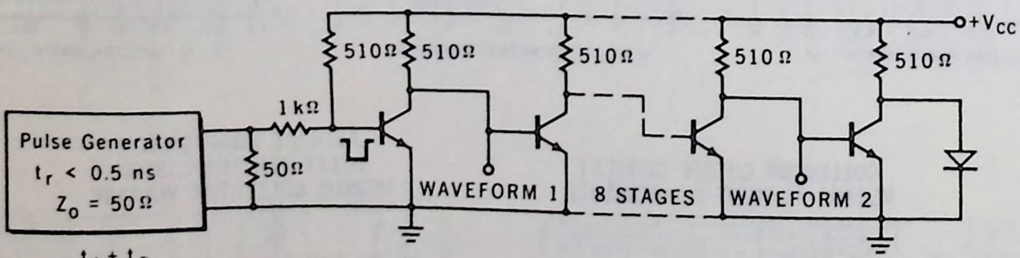
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %

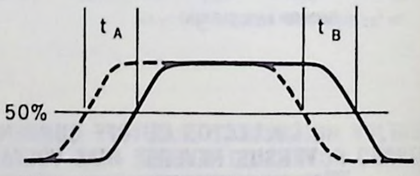

V_{in}
3.3 kΩ
220Ω
0.1μF
V_{out}
50Ω
3.3 kΩ
50Ω
0.0023μF
0.0023μF
0.005 μF
0.005μF
0.1μF
0.1μF
+
V_{BB}
−
+
$V_{CC} = 3V$
−


0
10 %
V_{in}
V_{out}
90 %
t_{off}
t_{off}
$V_{BB} = +12$ V
$V_{in} = -15$ V

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY


+V_{CC}
510Ω
510Ω
510Ω
510 Ω
510 Ω
1 kΩ
50Ω
Pulse Generator
t_r < 0.5 ns
Z_o = 50 Ω
WAVEFORM 1
8 STAGES
WAVEFORM 2



Waveforms 1 and 2 Superimposed

$\bar{t}pd = \frac{t_A + t_B}{20}$

$\bar{t}pd$ = Average Propagation per Transistor

2N2443

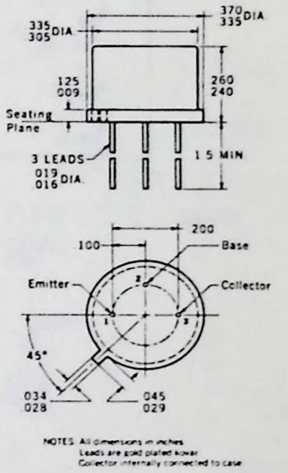
NPN HIGH-VOLTAGE AMPLIFIER AND OSCILLATOR

SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION The 2N2443 is designed for high-voltage amplifier and oscillator circuits where Planar performance and reliability are essential. A guaranteed LV_{CEO} of 100 volts, BV_{CBO} of 120 volts and 4 watt rating (see below for conditions) permit higher bias voltages and larger voltage swings as encountered in series and shunt regulators for power supplies and in servo amplifiers.

A typical gain-bandwidth product of 80 megacycles and low output capacitance makes this device useful for high-voltage video amplifiers, deflection plate drivers for oscilloscopes and output stages of operational amplifiers.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
Storage Temperature			-65°C to +300°C
Operating Junction Temperature			200°C Maximum
Maximum Power Dissipation			
Total Dissipation	at 25°C Case Temperature	(Notes 2 and 3)	4.0 Watts
	at 100°C Case Temperature	(Notes 2 and 3)	2.28 Watts
	at 25°C Ambient Temperature		0.8 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage		120 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	100 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	50	85	150		I_C = 50 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	80	120		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	35	80			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	20	55			I_C = 0.1 mA V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	20	35			I_C = 10 mA V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage	0.6	0.7	0.8	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.25	0.4	Volts	I_C = 10 mA I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage		0.8	0.9	Volts	I_C = 50 mA I_B = 5.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.7	1.2	Volts	I_C = 50 mA I_B = 5.0 mA
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.5	4.0			I_C = 50 mA V_{CE} = 10 V
C_{obo}	Output Capacitance		12	15	pf	I_E = 0 V_{CB} = 10 V
C_{ibo}	Input Capacitance		57	85	pf	I_C = 0 V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		0.4	10	nA	I_E = 0 V_{CB} = 90 V
I_{CBO}(150°C)	Collector Cutoff Current		1.0	15	μA	I_E = 0 V_{CB} = 90 V
NF	Noise Figure (Note 6)		5.0	15	db	I_C = 0.3 mA V_{CE} = 10 V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 4)	100			Volts	I_C = 30 mA (pulsed) I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	120			Volts	I_C = 0.1 mA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			Volts	I_C = 0 I_E = 0.1 mA
I_{EBO}	Emitter Cutoff Current		0.04	10	nA	I_C = 0 V_{EB} = 5.0 V

NOTES:

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(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.8°C/watt (derating factor of 22.8 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) Frequency = 1000 cps, Power Bandwidth = 200 cps, R_G = 510 Ω.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

SMALL SIGNAL CHARACTERISTICS (f = 1 KC)

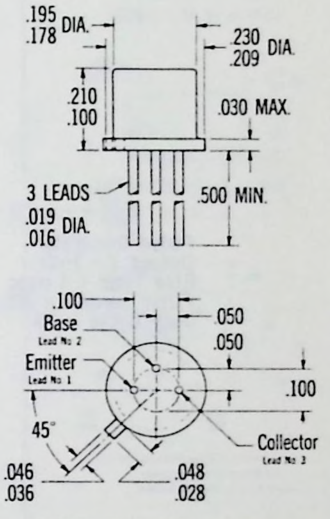
Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{ib}	Input Resistance	20	27	30	Ohms	I_C = 1.0 mA V_{CB} = 5.0 V
		4.0	6.3	8.0	Ohms	I_C = 5.0 mA V_{CB} = 5.0 V
h_{ob}	Output Conductance		0.11	0.5	µmho	I_C = 1.0 mA V_{CB} = 5.0 V
			0.16	1.0	µmho	I_C = 5.0 mA V_{CB} = 5.0 V
h_{rb}	Voltage Feedback Ratio		0.36	1.25	$x10^{-4}$	I_C = 1.0 mA V_{CB} = 5.0 V
			0.55	1.75	$x10^{-4}$	I_C = 5.0 mA V_{CB} = 5.0 V
h_{fe}	Small Signal Current Gain	30	62	120		I_C = 1.0 mA V_{CE} = 5.0 V
		45	68	150		I_C = 5.0 mA V_{CE} = 5.0 V
h_{ie}	Input Resistance		510	1000	Ohms	I_C = 5.0 mA V_{CE} = 5.0 V
h_{oe}	Output Conductance		12	50	µmho	I_C = 5.0 mA V_{CE} = 5.0 V

2N2475
NPN HIGH-SPEED SWITCH
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

ENERAL DESCRIPTION – The Fairchild 2N2475 is an NPN silicon PLANAR* epitaxial transistor designed pecifically for high-speed, low-power saturated switching applications.

Planar is a patented Fairchild process.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 10 sec time limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Free Air Temperature	[Notes 2 and 3]	0.3 Watt
at 100°C Case Temperature	[Notes 2 and 3]	0.5 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	15 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	6.0 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Collector Current	Limited by power dissipation

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain	30	150		I_C = 20 mA V_{CE} = 0.4 V
h_{FE}	DC Current Gain	20			I_C = 50 mA V_{CE} = 0.5 V
h_{FE}	DC Current Gain	20			I_C = 1.0 mA V_{CE} = 0.3 V
h_{FE} (-55°C)	DC Current Gain	15			I_C = 20 mA V_{CE} = 0.4 V
V_{BE}	Base-Emitter Voltage	0.8	1.0	Volt	I_C = 20 mA I_B = 0.66 mA
V_{CE}(sat)	Collector Saturation Voltage		0.4	Volt	I_C = 20 mA I_B = 0.66 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz.)	6.0			I_C = 20 mA V_{CE} = 2.0 V
C_{ob}	Output Capacitance		3.0	pF	I_E = 0 V_{CB} = 5.0 V
C_{ib}	Input Capacitance		2.5	pF	I_C = 0 V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		50	nA	I_E = 0 V_{CB} = 5.0 V
I_{CBO} (150°C)	Collector Cutoff Current		5.0	μA	I_E = 0 V_{CB} = 5.0 V
I_{EBO}	Emitter Cutoff Current		10	μA	I_C = 0 V_{EB} = 4.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	15		Volts	I_C = 10 μA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	6.0		Volts	I_C (pulsed) = 10 mA I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		Volts	I_E = 10 μA I_C = 0
τ_s	Charge Storage Time Constant (see Figure 1)		6.0	nsec	I_C = 5.0 mA, I_{B_1} = 5.0 mA, I_{B_2} = -5.0 mA
T_{on}	Turn On Time (see Figure 2)		20	nsec	I_C = 20 mA, I_{B_1} = 1.0 mA, I_{B_2} = -1.0 mA
T_{off}	Turn Off Time (see Figure 2)		15	nsec	I_C = 20 mA, I_{B_1} = 1.0 mA, I_{B_2} = -1.0 mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 583° C/watt (derating factor of 1.71 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 2%.

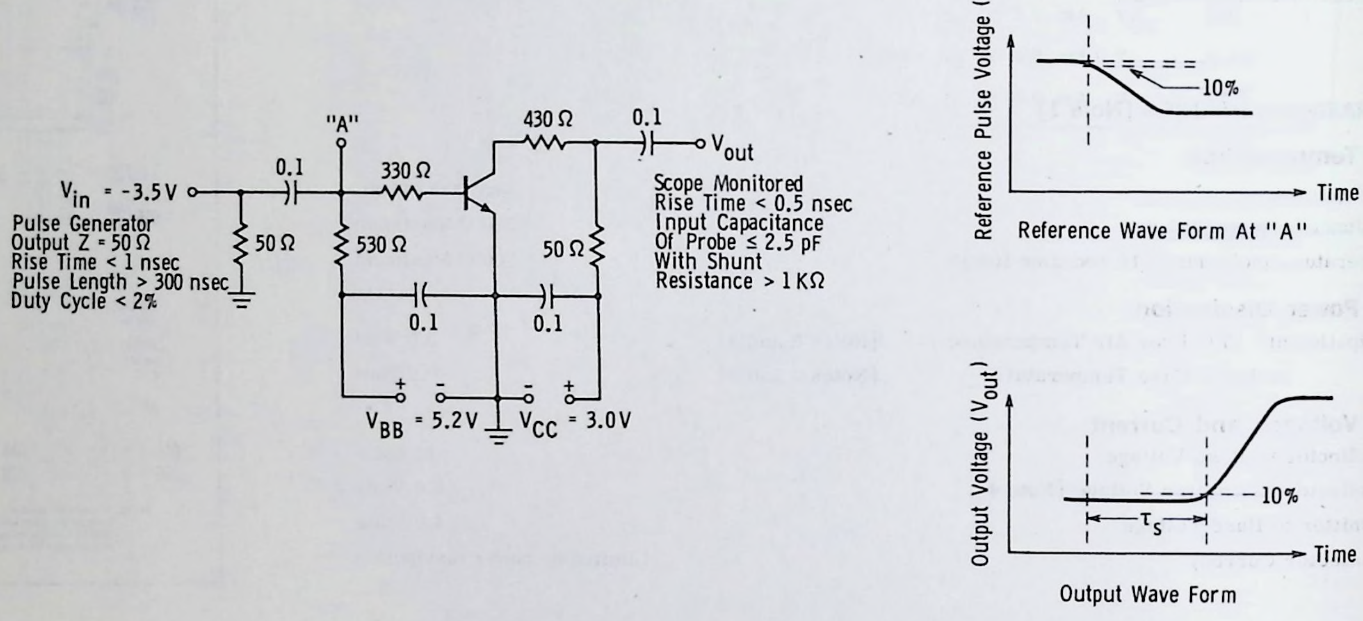
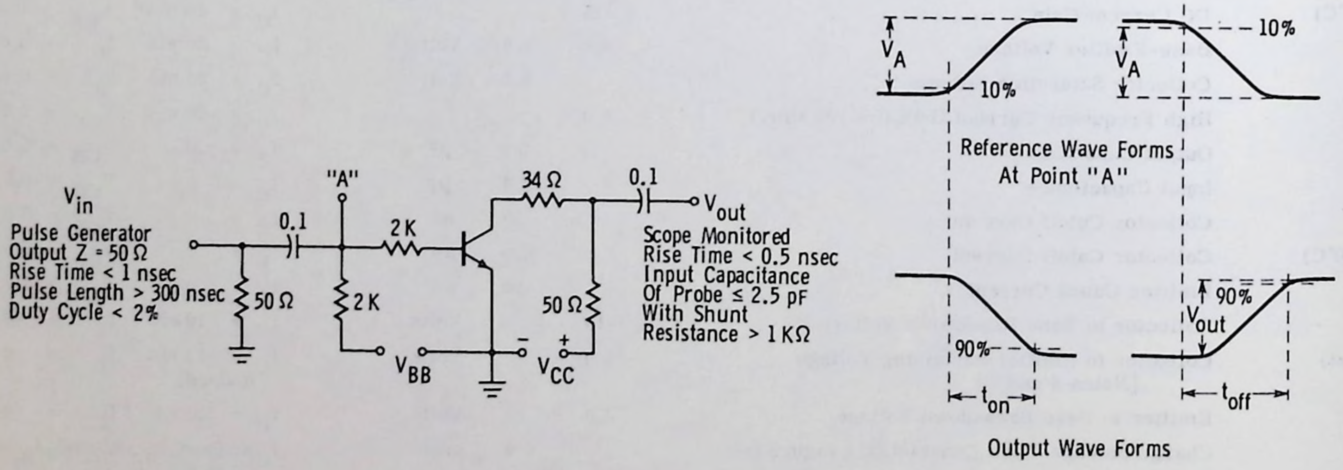

"A"
430 Ω
0.1
V_{out}
0.1
330 Ω
V_{in} = -3.5 V
Pulse Generator
Output Z = 50 Ω
Rise Time < 1 nsec
Pulse Length > 300 nsec
Duty Cycle < 2%
50 Ω
530 Ω
50 Ω
0.1
0.1
Scope Monitored
Rise Time < 0.5 nsec
Input Capacitance
Of Probe ≤ 2.5 pF
With Shunt
Resistance > 1 KΩ
V_{BB} = 5.2 V
V_{CC} = 3.0 V
Reference Pulse Voltage (V_A)
10%
Time
Reference Wave Form At "A"
Output Voltage (V_{out})
10%
τ_s
Time
Output Wave Form

Figure 1


V_{in}
Pulse Generator
Output Z = 50 Ω
Rise Time < 1 nsec
Pulse Length > 300 nsec
Duty Cycle < 2%
0.1
"A"
2K
34 Ω
0.1
V_{out}
50 Ω
2K
50 Ω
Scope Monitored
Rise Time < 0.5 nsec
Input Capacitance
Of Probe ≤ 2.5 pF
With Shunt
Resistance > 1 KΩ
V_{BB}
V_{CC}
V_A
10%
V_A
10%
Reference Wave Forms
At Point "A"
90%
V_{out}
90%
t_{on}
t_{off}
Output Wave Forms

t_{on}	t_{off}
V_{BB} = -1.0V	V_{BB} = +5.0V
V_{in} = +4.0V	V_{in} = -4.0V
V_{CC} = +1.8V	V_{CC} = +1.8V

Figure 2

2N2476 · 2N2477

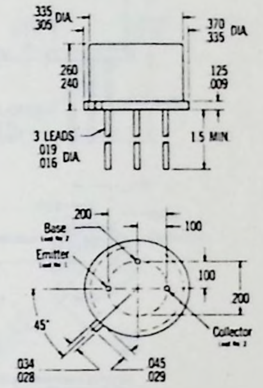
FAIRCHILD NPN SILICON PLANAR EPITAXIAL TRANSISTORS

HIGH-SPEED SWITCHES

FOR IMPROVED PERFORMANCE
SEE FAIRCHILD 2N2848

GENERAL DESCRIPTION - The Fairchild 2N2476 and 2N2477 are NPN silicon PLANAR epitaxial transistors designed specifically for high-speed saturated switching applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		-65°C to +300°C
Operating Junction Temperature		200°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		2.0 Watts
at 25°C Ambient Temperature (Notes 2 and 3)		0.6 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	Limited by power dissipation only

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

		2N2476		2N2477				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain	20		40			I_C = 150 mA	V_{CE} = 0.4 V
V_{BE}	Base-Emitter Voltage		1.0			Volts	I_C = 150 mA	I_B = 7.5 mA
V_{BE}	Base-Emitter Voltage				0.95	Volts	I_C = 150 mA	I_B = 3.75 mA
V_{CE}(sat)	Collector Saturation Voltage		0.4			Volts	I_C = 150 mA	I_B = 7.5 mA
V_{CE}(sat)	Collector Saturation Voltage				0.4	Volts	I_C = 150 mA	I_B = 3.75 mA
V_{CE}(sat)	Collector Saturation Voltage		0.75		0.65	Volts	I_C = 500 mA	I_B = 50 mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	2.5		2.5			I_C = 50 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		10		10	pf	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current		0.2		0.2	μA	I_E = 0	V_{CB} = 30 V
I_{CBO}(150°C)	Collector Cutoff Current		200		200	μA	I_E = 0	V_{CB} = 30 V
I_{EBO}	Emitter Cutoff Current		100		100	μA	I_C = 0	V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		Volts	I_C = 10 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	20		20		Volts	I_C = 50 mA(pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		Volts	I_E = 100 μA	I_C = 0
t_s	Storage Time (Note 6)		25		25	nsec	I_C ≈ 150 mA,	I_{B1} ≈ 15 mA, I_{B2} ≈ -15 mA
t_{on}	Turn On Time (Note 7)		25		25	nsec	I_C ≈ 150 mA	I_{B1} ≈ 15 mA
t_{off}	Turn Off Time (Note 6)		45		45	nsec	I_C ≈ 150 mA,	I_{B1} ≈ 15 mA, I_{B2} ≈ -15 mA

NOTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 87.5°C/watt (derating factor of 11.4 mW/°C, junction-to-ambient thermal resistance of 292°C/watt (derating factor of 3.42 mW/°C).

Rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length ≤ 400 μsec; duty cycle ≤ 3%.

See Figure 2 for exact values of I_C, I_{B1}, and I_{B2}.

See Figure 1 for exact values of I_C and I_{B1}.

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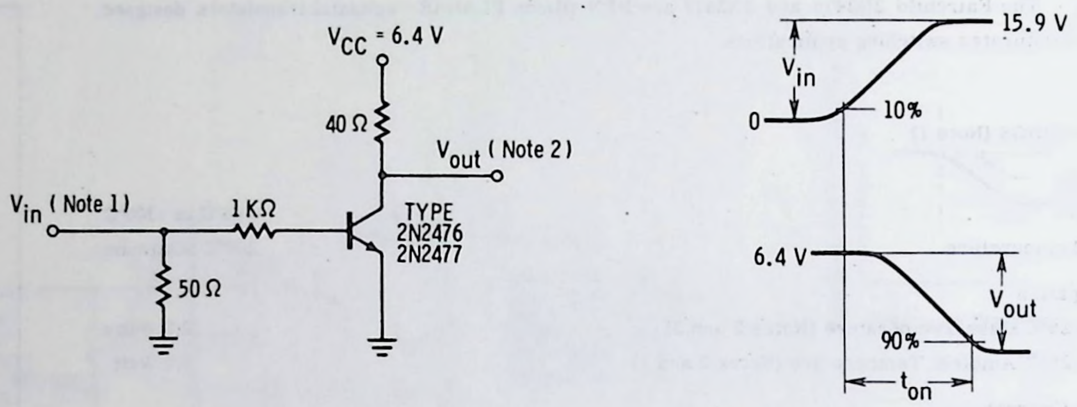
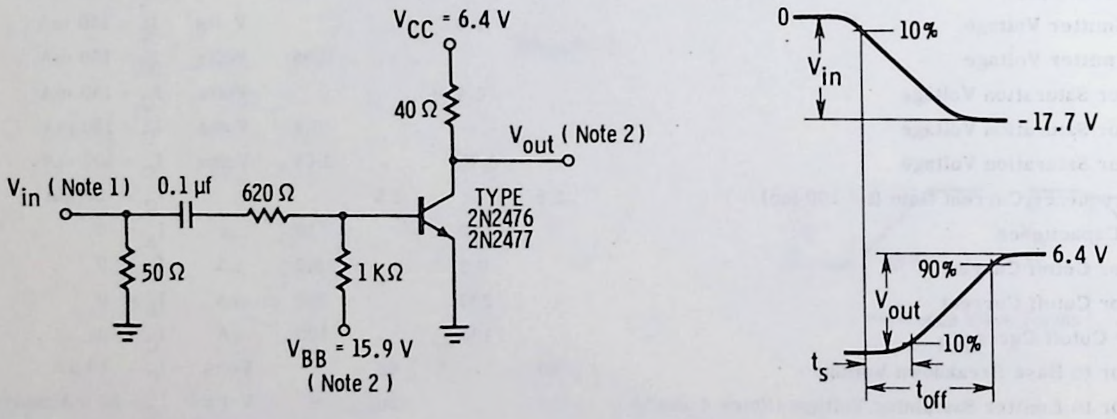
FIGURE 1 — Turn-On Test Circuit



V_{CC} = 6.4 V
40 Ω
V_{out} (Note 2)
V_{in} (Note 1)
1 KΩ
TYPE
2N2476
2N2477
50 Ω
15.9 V
V_{in}
0
10%
6.4 V
V_{out}
90%
t_{on}

FIGURE 2 — Turn-Off and Storage Time Test Circuit



V_{CC} = 6.4 V
40 Ω
V_{out} (Note 2)
V_{in} (Note 1)
0.1 µf
620 Ω
TYPE
2N2476
2N2477
50 Ω
1 KΩ
V_{BB} = 15.9 V
(Note 2)
0
10%
V_{in}
- 17.7 V
6.4 V
90%
V_{out}
10%
t_s
t_{off}

Note 1: Input voltage (V_{IN}) obtained from mercury-relay type pulse generator having an output impedance of 50 ohms. V_{IN} rise time <2 nsec; pulse duration >150 nsec; and duty factor <2%.

Note 2: Input and output waveforms monitored by means of a sampling oscilloscope or other indicating device having a rise time <0.5 nsec; input capacitance of probe <2.5 pf with shunt resistance of 1 megohm.

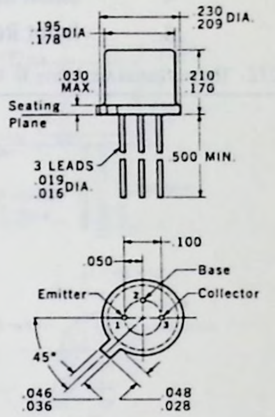
2N2483 • 2N2484

NPN LOW LEVEL, LOW NOISE TYPE

DIFFUSED SILICON PLANAR TRANSISTORS

The 2N2483 and 2N2484 are NPN double-diffused silicon PLANAR transistors designed for use in high-performance, ow-level, low-noise amplifier circuits from audio through high-frequency ranges.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Note 2 and 3]	1.2 Watts
at 100°C Case Temperature [Note 2 and 3]	0.68 Watt
at 25°C Ambient Temperature [Note 2 and 3]	0.36 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	60 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	60 Volts
V_{EBO} Emitter to Base Voltage	6.0 Volts
I_C Collector Current	50 mA

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N2483			2N2484					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]		280	500		430	800		I_C = 10 mA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	175	230		250	450			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	100	200		200	430			I_C = 500 μA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	75	140		175	375			I_C = 100 μA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	40	80	120	100	290	500		I_C = 10 μA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain				30	200			I_C = 1.0 μA	V_{CE} = 5.0 V
h_{FE} (−55°C)	DC Current Gain	10			20				I_C = 10 μA	V_{CE} = 5.0 V
V_{BE} (on)	Emitter-Base On Voltage	0.5	0.57	0.7	0.5	0.57	0.7	Volts	I_C = 100 μA	V_{CE} = 5.0 V
V_{CE} (sat)	Collector Saturation Voltage		0.2	0.35		0.2	0.35	Volts	I_C = 1.0 mA	I_B = 0.1 mA
h_{fe}	High Frequency Current Gain (f = 5.0 mc)	2.4	4.0		3.0	4.0			I_C = 50 μA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 30 mc)	2.0	2.3		2.0	2.6			I_C = 500 μA	V_{CE} = 5.0 V
I_{CBO}	Collector Cutoff Current		0.1	10		0.1	10	nA	I_E = 0	V_{CB} = 45 V
I_{CBO} (150°C)	Collector Cutoff Current		0.2	10		0.2	10	μA	I_E = 0	V_{CB} = 45 V
I_{EBO}	Emitter Cutoff Current		0.1	10		0.1	10	nA	I_C = 0	V_{EB} = 5.0 V
I_{CEO}	Collector-Emitter Cutoff Current		0.1	2.0		0.1	2.0	nA	I_B = 0	V_{CE} = 5.0 V
C_{obo}	Output Capacitance		3.5	6.0		3.5	6.0	pf	I_E = 0	V_{CB} = 5.0 V
C_{TE}	Emitter Transition Capacitance		3.5	6.0		3.5	6.0	pf	I_C = 0	V_{EB} = 0.5 V
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			Volts	I_C = 10 μA	I_E = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 4 and 5]	60			60			Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	I_C = 0	I_E = 10 μA
NF	Wide Band Noise Figure [Note 6]		1.9	4.0		1.8	3.0	db	I_C = 10 μA	V_{CE} = 5.0 V
NF	Narrow Band Noise Figure [Note 7]		1.9	4.0		1.8	3.0	db	I_C = 10 μA	V_{CE} = 5.0 V
NF	Narrow Band Noise Figure [Note 8]		0.7	3.0		0.6	2.0	db	I_C = 10 μA	V_{CE} = 5.0 V
NF	Narrow Band Noise Figure [Note 9]		4.0	15		4.0	10	db	I_C = 10 μA	V_{CE} = 5.0 V

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.1 mW/°C).
These ratings refer to a high-current point where collector-to-emitter voltage is lowest.
Pulse Conditions: length = 300 μsec; duty cycle = 1%.
R_S = 10 KΩ; Power Bandwidth of 15.7 Kc with 3 db points at 10 cycles and 10 Kc.
f = 1 Kc; R_S = 10 KΩ; Power Bandwidth of 200 cps.
f = 10 Kc; R_S = 10 KΩ; Power Bandwidth of 2 Kc.
f = 100 cps; R_S = 10 KΩ; Power Bandwidth of 20 cps.

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SMALL SIGNAL CHARACTERISTICS (f = 1KC)

SYMBOL	FACT † SUBGROUP	CHARACTERISTIC	2N2483 MIN.	2N2483 TYP.	2N2483 MAX.	2N2484 MIN.	2N2484 TYP.	2N2484 MAX.	UNITS	TEST CONDITIONS
h_{ie}	4	Input Resistance	1.5	7.5	13	3.5	15	24	Kohms	$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{oe}	4	Output Conductance		11	30		15	40	μmho	$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{re}	4	Voltage Feedback Ratio		300	800		425	800	$\times 10^{-6}$	$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{fe}	4	Small Signal Current Gain	80	280	450	150	400	900		$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{ib}	4	Input Resistance	25	27	32	25	27	32	ohms	$I_C = 1.0$ mA $V_{CB} = 5.0$V

† NOTE: These Numerals Apply to the Fairchild FACT Program.

2N2509 • 2N2510 • 2N2511

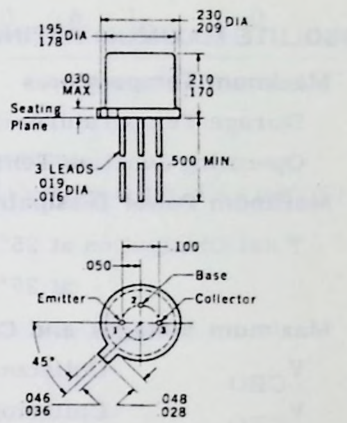
NPN LOW-LEVEL, LOW-NOISE

DIFFUSED SILICON PLANAR* TRANSISTORS

HIGH GAIN . . . . . $h_{FE} = 40$ (MIN) (2N2509) AT 10 mA
. . . . . $h_{FE} = 150\text{-}500$ (2N2510) AT 10 mA
. . . . . $h_{FE} = 240\text{-}750$ (2N2511) AT 10 mA
HIGH VOLTAGE . . . $LV_{CEO} = 80$ V (MIN) (2N2509)
. . . $LV_{CEO} = 65$ V (MIN) (2N2510)
. . . $LV_{CEO} = 50$ V (MIN) (2N2511)
LOW NOISE . . . . . NF = 4.0 dB (MIN) (2N2510/11) AT 1.0 kHz

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-18) outline



NOTES:
All dimensions in inches
Leads are gold-plated Kovar
Collector internally connected to case
Package weight is 0.43 gram

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +300°C
Operating Junction Temperature	+200°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.2 Watts
at 100°C Case Temperature (Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages

		2N2509	2N2510	2N2511
V_{CBO}	Collector to Base Voltage	125 Volts	100 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	80 Volts	65 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts	7.0 Volts	7.0 Volts

CTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N2509		2N2510		2N2511				
SYMBOL	CHARACTERISTICS	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	**40**		**150**	**500**	**240**	**750**		$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	25		75		120			$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}(−55°C)	DC Current Gain	20		60		100			$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{FE}(−55°C)	DC Current Gain			25		40			$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain					80			$I_C = 1.0\ \mu A$	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage		1.0		1.0		1.0	Volts	$I_C = 5.0$ mA	$I_B = 0.5$ mA
$V_{BE(sat)}$	Base-Emitter Voltage		0.9		0.9		0.9	Volts	$I_C = 5.0$ mA	$I_B = 0.5$ mA
h_{fe}	High-Frequency Current Gain (f = 30 MHz)	1.5		1.5		1.5			$I_C = 5.0$ mA	$V_{CE} = 10$ V
$_{CBO}$	Collector Cutoff Current		5.0					nA	$I_E = 0$	$V_{CB} = 100$ V
$_{CBO}$	Collector Cutoff Current				5.0			nA	$I_E = 0$	$V_{CB} = 80$ V
$_{CBO}$	Collector Cutoff Current						5.0	nA	$I_E = 0$	$V_{CB} = 60$ V
$_{CBO}$(150°C)	Collector Cutoff Current		10					μA	$I_E = 0$	$V_{CB} = 100$ V
$_{CBO}$(150°C)	Collector Cutoff Current				10			μA	$I_E = 0$	$V_{CB} = 80$ V
$_{CBO}$(150°C)	Collector Cutoff Current						10	μA	$I_E = 0$	$V_{CB} = 60$ V
$_{EBO}$	Emitter Cutoff Current		2.0		2.0		2.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
$_{obo}$	Output Capacitance (f = 1.0 MHz)		6.0		6.0		6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
$_{ibo}$	Input Capacitance (f = 1.0 MHz)		10		10		10	pF	$I_C = 0$	$V_{EB} = 0.5$ V
F	**Noise Figure (f = 1.0 KHz)**		**7.0**		**4.0**		**4.0**	dB	$I_C = 10\ \mu A$ BW = 200 Hz	$V_{CE} = 5.0$ V $R_{GT} = 10\ k\Omega$
$'C_c$	Collector-Base Time Constant (f = 4.0 MHz)		800		800		800	ps	$I_C = 10$ mA	$V_{CB} = 10$ V
V_{CBO}	Collector to Base Breakdown Voltage	125		100		80		Volts	$I_C = 10\ \mu A$	$I_E = 0$
$_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Note 4)	**80**		**65**		**50**		**Volts**	$I_C = 10$ mA	$I_B = 0$
V_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		7.0		Volts	$I_E = 0.1\ \mu A$	$I_C = 0$

*Planar is a patented Fairchild process.

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction to ambient hermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).
Rating refers to a high-current point where collector to emitter voltage is lowest.

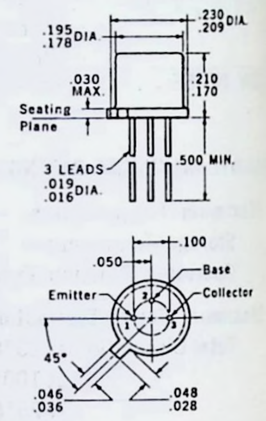
2N2586

NPN LOW-LEVEL, LOW-NOISE

DIFFUSED SILICON PLANAR* TRANSISTOR

GENERAL DESCRIPTION The Fairchild 2N2586 is an NPN PLANAR transistor designed for use in low-level, low-noise amplifier circuits from audio through high-frequency ranges.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	175°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.6 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.3 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	30 mA

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)		600		I_C = 10 mA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	150			I_C = 500 μA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	120	360		I_C = 10 μA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	80			I_C = 1.0 μA	V_{CE} = 5.0 V
h_{FE}(-55°C)	DC Current Gain	40			I_C = 10 μA	V_{CE} = 5.0 V
V_{CE}(sat)	Collector Saturation Voltage		0.5	Volts	I_C = 10 mA	I_B = 0.5 m
V_{BE}	Base-Emitter Voltage	0.7	0.9	Volts	I_C = 10 mA	I_B = 0.5 m
h_{fe}	High Frequency Current Gain (f = 30 MHz)	1.5			I_C = 500 μA	V_{CE} = 5.0 V
C_{obo}	Common Base Open Circuit Output Capacitance (f = 1.0 MHz)		7.0	pF	I_E = 0	V_{CB} = 5.0 V
BO	Collector Cutoff Current		2.0	nA	I_E = 0	V_{CB} = 45 V
ES	Collector-Emitter Cutoff Current		2.0	nA	V_{CE} = 45 V	V_{BE} = 0
CES(170°C)	Collector-Emitter Cutoff Current		10	μA	V_{CE} = 45 V	V_{BE} = 0
I_{CEO}	Collector-Emitter Cutoff Current		2.0	nA	I_B = 0	V_{CE} = 5.0 V
I_{EBO}	Emitter Cutoff Current		2.0	nA	I_C = 0	V_{EB} = 5.0 V
NF	Spot Noise Figure (R_G = 1 MΩ; f = 10 kHz)		2.0	dB	I_C = 1.0 μA	V_{CE} = 5.0 V
NF	Spot Noise Figure (R_G = 10 kΩ; f = 10 kHz)		2.0	dB	I_C = 10 μA	V_{CE} = 5.0 V
NF	Spot Noise Figure (R_G = 10 kΩ; f = 1.0 kHz)		3.0	dB	I_C = 10 μA	V_{CE} = 5.0 V
NF	Spot Noise Figure (R_G = 1 MΩ; f = 1.0 kHz)		3.5	dB	I_C = 1.0 μA	V_{CE} = 5.0 V

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* Planar is a patented Fairchild pro

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LECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

YMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
ie	Input Resistance (f = 1.0 kHz)	4.5	18	Kohms	I_C = 1.0 mA V_{CE} = 5.0 V
oe	Output Admittance (f = 1.0 kHz)		100	μmhos	I_C = 1.0 mA V_{CE} = 5.0 V
fe	Small Signal Current Gain (f = 1.0 kHz)	150	600		I_C = 1.0 mA V_{CE} = 5.0 V
W_{CBO}	Collector to Base Breakdown Voltage	60		Volts	I_C = 10 μA I_E = 0
$CEO^{(sust)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	45		Volts	I_C = 10 mA (pulsed) I_B = 0
W_{EBO}	Emitter to Base Breakdown Voltage	6.0		Volts	I_E = 10 μA I_C = 0

NOTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 250°C/Watt (derating factor of 4.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

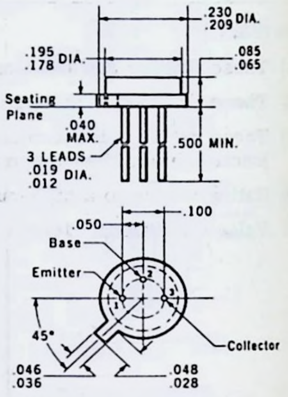
5) Pulse Conditions: length = 300 μsec; duty cycle ≤ 2%.

2N2605

PNP LOW LEVEL, LOW NOISE TYPE
DIFFUSED SILICON PLANAR II TRANSISTOR

GENERAL DESCRIPTION - The Fairchild 2N2605 is a PNP double-diffused silicon PLANAR II transistor designed for use in high-performance, low-level, low-noise amplifiers from audio to high frequency ranges.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Lead Temperature (Soldering, 1/16" ±1/32", 10 sec time limit)	230°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.2 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.4 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		-60 Volts
V_{CEO}	Collector to Emitter Voltage	(Notes 4 and 5)	-45 Volts
V_{EBO}	Emitter to Base Voltage		-6.0 Volts
I_C	Collector Current		30 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain (T_A = -55°C)	20			I_C = 10 μA	V_{CE} = -5.0 V
h_{FE}	DC Current Gain	100	300		I_C = 10 μA	V_{CE} = -5.0 V
h_{FE}	DC Current Gain	150			I_C = 500 μA	V_{CE} = -5.0 V
h_{FE}	DC Current Gain (Notes 4 & 5)		600		I_C = 10 mA	V_{CE} = -5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	-60		Volts	I_C = 10 μA	I_E = 0
LV_{CEO}	Collector to Emitter Limiting Voltage (Notes 4 & 5)	-45		Volts	I_C = 10 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		Volts	I_C = 0	I_E = 10 μA
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = -45 V
I_{CES}	Collector Reverse Current		10	nA	V_{CE} = -45 V	V_{EB} = 0
I_{CES}	Collector Reverse Current (T_A = 170°C)		10	μA	V_{CE} = -45 V	V_{EB} = 0
I_{EBO}	Emitter Cutoff Current		2.0	nA	I_C = 0	V_{EB} = -5.0 V

FAIRCHILD TRANSISTOR 2N2605

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics	Min.	Max.	Units	Test Conditions
V_{BE}(sat)	Base Saturation Voltage (Notes 4 & 5)	-0.7	-0.9	Volts	I_C = 10 mA I_B = 0.5 mA
V_{CE}(sat)	Collector Saturation Voltage (Notes 4 & 5)		-0.5	Volts	I_C = 10 mA I_B = 0.5 mA
h_{fe}	High Frequency Current Gain (f = 30 Mc)	1.0			I_C = 0.5 mA V_{CE} = -5.0 V
C_{obo}	Common-base, Open-circuit Output Capacitance (f = 1.0 Mc)		6.0	pf	I_E = 0 V_{CB} = 5.0 V
NF	Wide Band Noise Figure (f = 10 Kc) (Note 6)		3.0	db	I_C = 10 μA V_{CE} = -5.0 V
$R_e(h_{ie})$	Real Part, Input Impedance (f = 100 Mc)		200	Ohms	I_C = 1.0 mA V_{CE} = 5.0 V

ALL SIGNAL CHARACTERISTICS (f = 1 Kc)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{ib}	Input Resistance	25	35	Ohms	I_E = 1.0 mA V_{CB} = -5.0 V
h_{ob}	Output Conductance		1.0	μmho	I_E = 1.0 mA V_{CB} = -5.0 V
h_{fe}	Small Signal Current Gain	150	600		I_E = 1.0 mA V_{CE} = -5.0 V
h_{rb}	Voltage Feedback Ratio		10	$\times 10^{-4}$	I_E = 1.0 mA V_{CB} = -5.0 V

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C; junction-to-ambient thermal resistance of 438°C/Watt (derating factor of 2.28 mW/°C).

These ratings refer to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μsec; duty cycle = 1%.

R_{gg} = 10 KOhms, Power Bandwidth = 15.7 Kc.

2N2616 • 2N2729

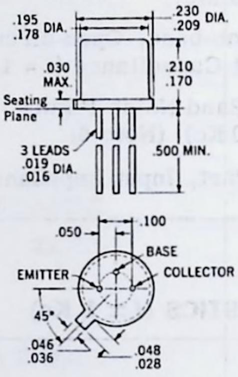
NPN ULTRA-HIGH FREQUENCY OSCILLATOR AND AMPLIFIER TYPE

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The 2N2616 and 2N2729 are NPN Double-Diffused Silicon Planar Epitaxial Transistors. They are designed for low-noise, high-frequency amplifiers; 1 GHz local oscillators; non-neutralized IF amplifiers and non-saturating circuits with rise and fall times of less than 2.5 nanoseconds.

PHYSICAL DIMENSIONS

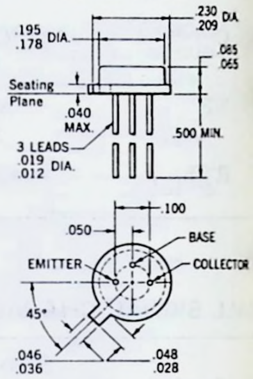
in accordance with JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated Kovar*
Lead No. 3 internally connected to case
Package weight is 0.44 gram

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated Kovar
Lead No. 3 internally connected to case
Package weight is 0.34 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, No Time Limit)	+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.8 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.3 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Current Gain	20	50			$I_C = 3.0$ mA $V_{CE} = 1.0$ V
$V_{BE}(sat)$	Pulsed Base-Emitter Saturation Voltage (Note 6)			1.0	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
$V_{CE}(sat)$	Pulsed Collector-Emitter Saturation Voltage (Note 6)			0.4	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
C_{obo}	Output Capacitance		2.4	2.8	pF	$I_E = 0$ $V_{CB} = 10$ V
C_{ibo}	Input Capacitance			2.0	pF	$I_C = 0$ $V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current			10	nA	$I_E = 0$ $V_{CB} = 15$ V
$I_{CBO}(150°C)$	Collector Cutoff Current			1.0	μA	$I_E = 0$ $V_{CB} = 15$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	6.0	9.0			$I_C = 4.0$ mA $V_{CE} = 10$ V
A_p	Available Power Gain (neutralized) (f = 200 MHz)	15	18		dB	$I_C = 6.0$ mA $V_{CE} = 12$ V
P_o	Power Output (f = 500 MHz)	30	45		mW	$I_C = 8.0$ mA $V_{CE} = 15$ V
	Collector Efficiency (f = 500 MHz)	25			%	$I_C = 8.0$ mA $V_{CE} = 15$ V
NF	Noise Figure (Note 5)			6.0	dB	$I_C = 1.0$ mA $V_{CE} = 6.0$ V
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Note 4)	15			Volts	$I_C = 3.0$ mA $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 1.0$ μA $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	$I_C = 0$ $I_E = 10$ μA

* Planar is a patented Fairchild proces

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) f = 60 MHz, $R_G = 400\Omega$.

(6) Pulse Conditions: length = 300μs; duty cycle $\leq 1\%$

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATIO
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

2N2695 • 2N2696 • 2N2927

PNP VHF AMPLIFIERS, HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

The 2N2695, 2N2696, and 2N2927 are PNP silicon PLANAR epitaxial transistors designed for digital and analog applications at current levels to 500 milliamperes. The high gain-bandwidth product, f_T, at high currents, makes them excellent units for line driving and memory applications.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures		2N2695	2N2696	2N2927
	Storage Temperature	−65°C to +200°C	−65°C to +200°C	−65°C to +200°C
	Operating Junction Temperature	200°C Maximum	200°C Maximum	200°C Maximum
	Lead Temperature (Soldering, 60 sec Time Limit)	300°C Maximum	300°C Maximum	300°C Maximum
Maximum Power Dissipation				
	Total Dissipation at 25°C Case Temperature [Note 2 and 3]	2.0 Watts	1.2 Watts	3.0 Watts
	at 100°C Case Temperature [Note 2 and 3]	1.0 Watt	0.68 Watt	1.7 Watts
	at 25°C Ambient Temperature [Note 2 & 3]	0.36 Watt	0.36 Watt	0.8 Watt
Maximum Voltages				
V_{CBO}	Collector to Base Voltage	−25 Volts	−25 Volts	−25 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−25 Volts	−25 Volts	−25 Volts
V_{EBO}	Emitter to Base Voltage	−4.0 Volts	−4.0 Volts	−4.0 Volts
I_C	Collector Current [Note 2]	500 mA	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	130		$I_C = 50$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	20			$I_C = 300$ mA	$V_{CE} = -2.0$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12			$I_C = 50$ mA	$V_{CE} = -1.0$ V
V_{BE}(sat)	Base Saturation Voltage		−1.1	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{BE}(sat)	Base Saturation Voltage		−2.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{CE}(sat)	Collector Saturation Voltage		−0.25	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{CE}(sat)	Collector Saturation Voltage		−1.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	1.0			$I_C = 50$ mA	$V_{CE} = -3.0$ V
$_{ob}$	Output Capacitance		20	pf	$I_E = 0$	$V_{CB} = -10$ V
$_{CBO}$	Collector Cutoff Current		25	nA	$I_E = 0$	$V_{CB} = -10$ V
$_{CBO}$ (150°C)	Collector Cutoff Current		5.0	μA	$I_E = 0$	$V_{CB} = -10$ V
V_{CBO}	Collector to Base Breakdown Voltage	−25		Volts	$I_C = 100$ μA	$I_E = 0$
$_{CEO}$ (sust)	Collector to Emitter Sustaining Voltage [Note 4 & 5]	−25		Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
V_{EBO}	Emitter to Base Breakdown Voltage	−4.0		Volts	$I_C = 0$	$I_E = 100$ μA
$_{on}$	Turn On Time [Note 6]		75	nsec	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
$_{off}$	Turn Off Time [Note 6]		170	nsec	$I_C \approx 300$ mA $I_{B1} \approx 30$ mA	$I_{B2} \approx -30$ mA

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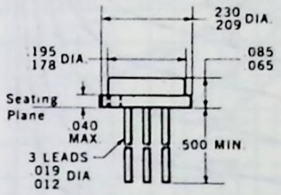
NOTES:

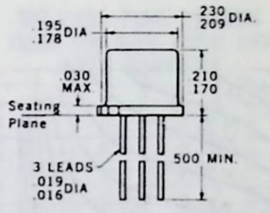
These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 87.5°C/watt (derating factor of 111.4 mW/°C) for the 2N2695; for the 2N2696 146°C/watt (derating factor of 6.9 mW/°C); for the 2N2927 58.3°C/watt (derating factor of 117.2 mW/°C). Junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.1 mW/°C) for the 2N2695 and 2N2696; for the 2N2927 219°C/watt (derating factor of 4.56 mW/°C).
Rating refers to a high current point where collector-to-emitter voltage is lowest.
Pulse Conditions: length = 300 μsec; duty cycle = 1%.
See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline

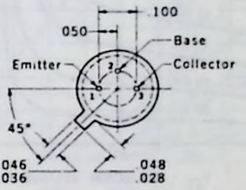


2N2695

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



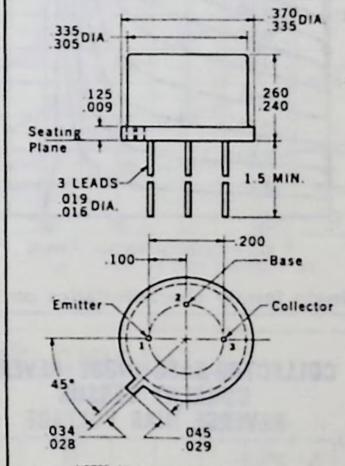
2N2696



NOTES. All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2695 2N2696

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES. All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

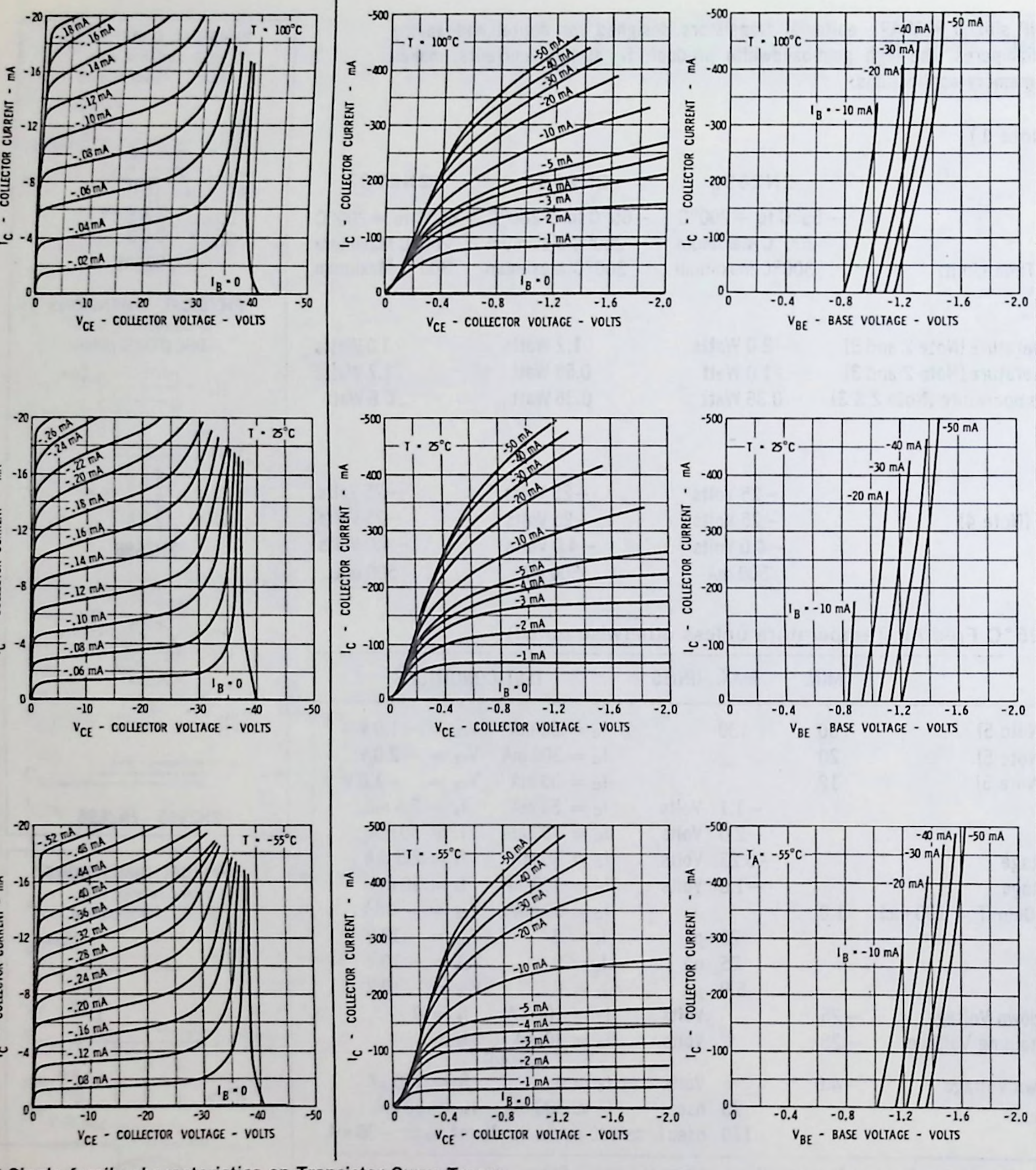
2N2927

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

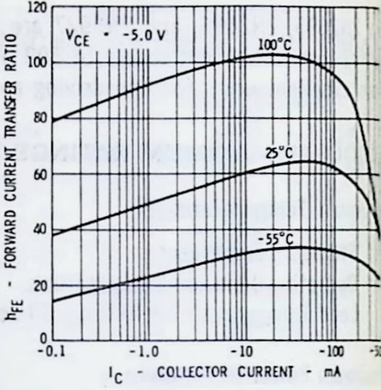
ACTIVE REGION

SATURATION REGION

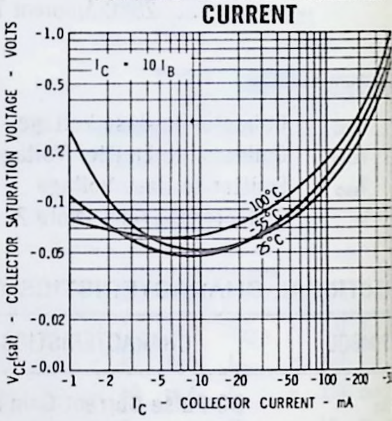


* Single family characteristics on Transistor Curve Tracer

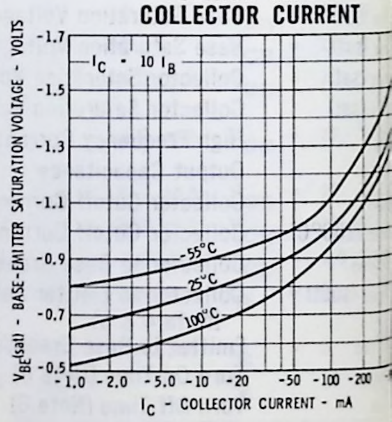
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



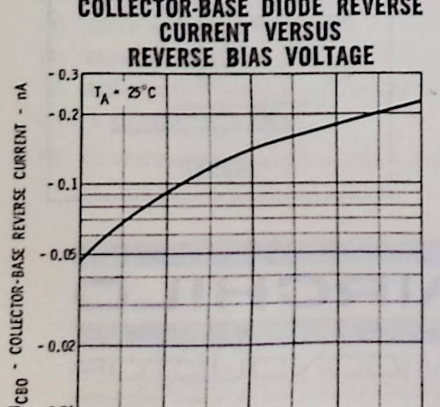
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



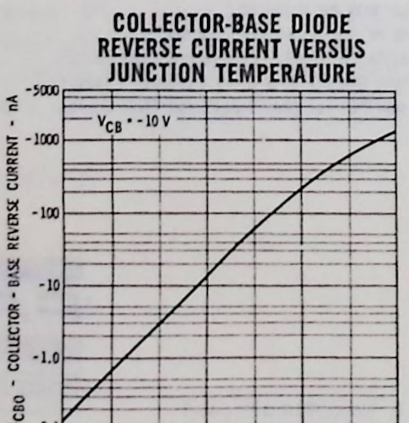
BASE-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



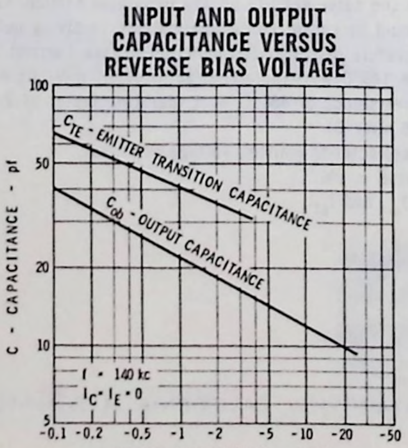
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



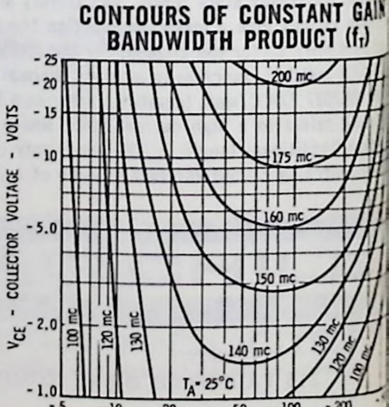
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS JUNCTION TEMPERATURE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

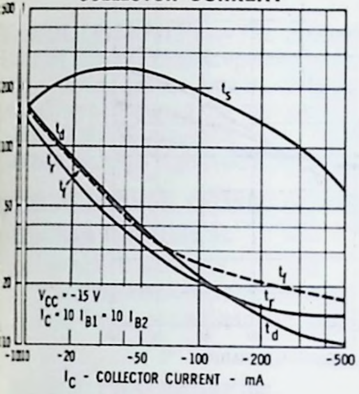


CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

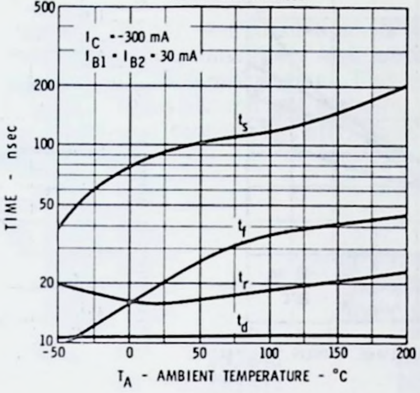


TYPICAL ELECTRICAL CHARACTERISTICS

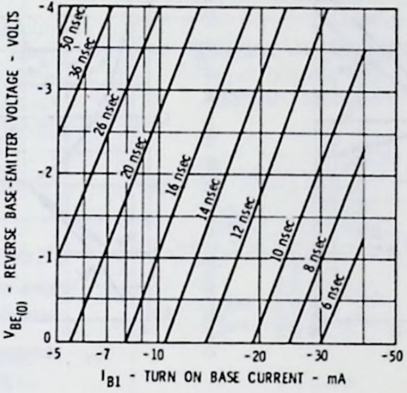
SWITCHING TIMES VERSUS COLLECTOR CURRENT



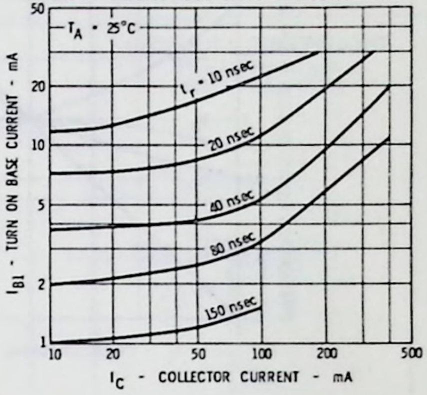
SWITCHING TIMES VERSUS TEMPERATURE



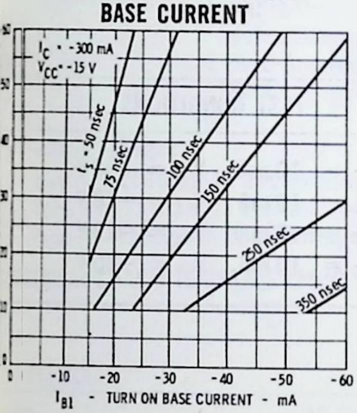
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



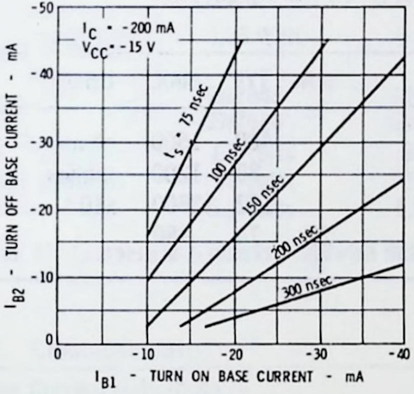
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



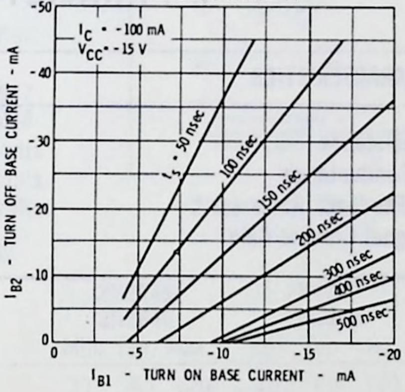
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



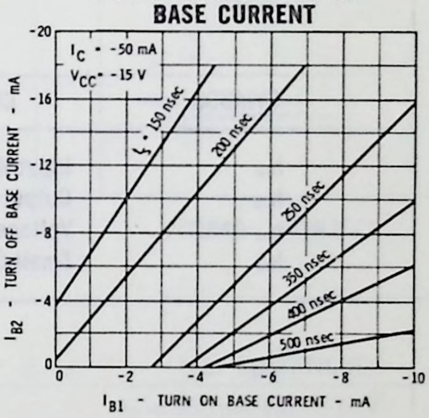
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



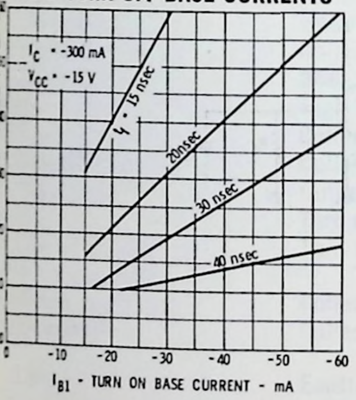
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



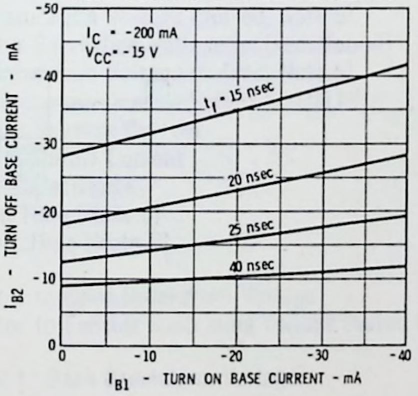
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



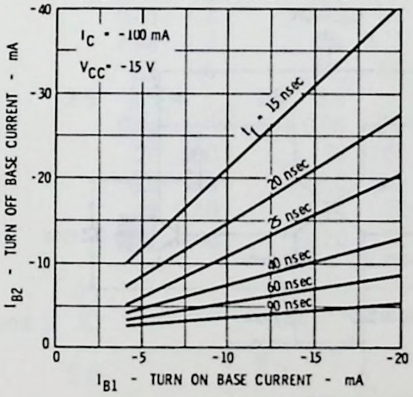
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



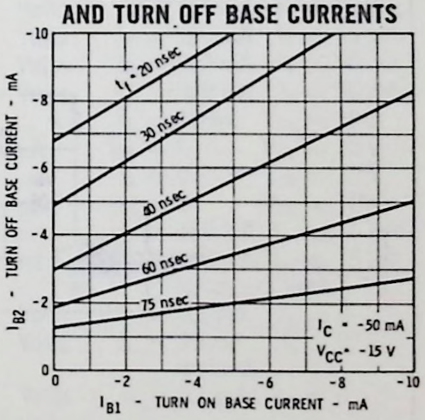
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



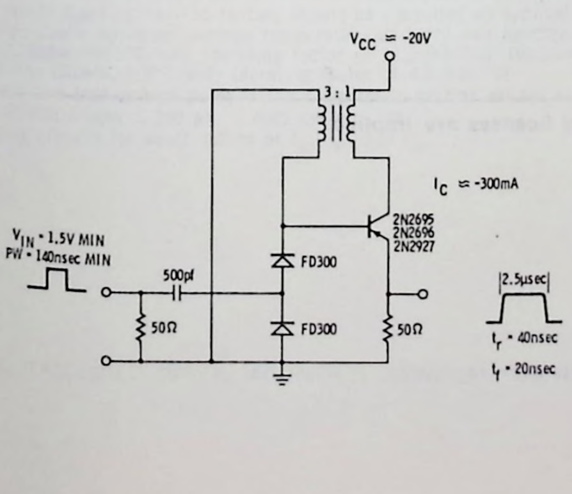
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



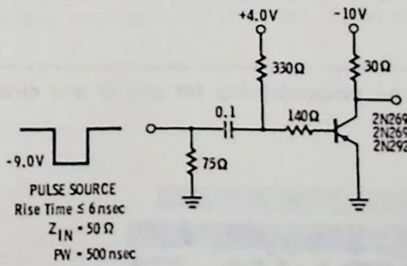
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



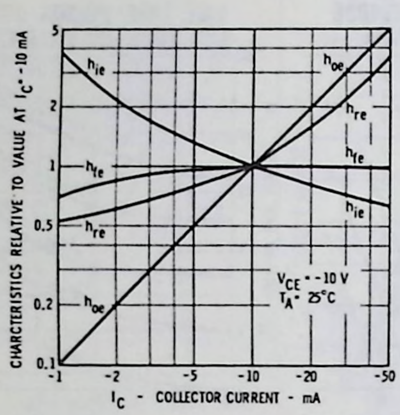
MONOSTABLE BLOCKING OSCILLATOR

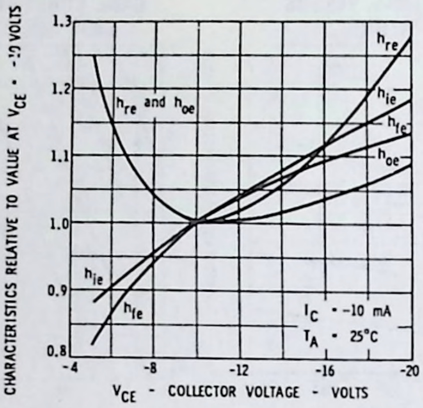

V_CC = -20V
3 : 1
I_C = -300mA
2N2695
2N2696
2N2927
V_IN = 1.5V MIN
PW = 140nsec MIN
500pf
FD300
FD300
50Ω
50Ω
2.5μsec
t_r = 40nsec
t_f = 20nsec

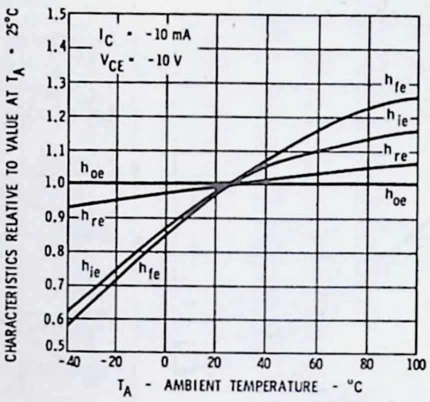
T$_{on}$ and T$_{off}$ TEST CIRCUIT


+4.0V
-10V
330Ω
30Ω
0.1
140Ω
75Ω
2N2695
2N2696
2N2927
-9.0V
PULSE SOURCE
Rise Time ≤ 6 nsec
Z_IN = 50 Ω
PW = 500 nsec

SMALL SIGNAL CHARACTERISTICS



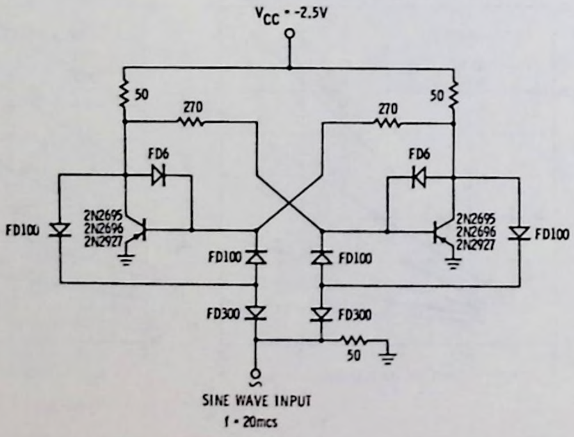




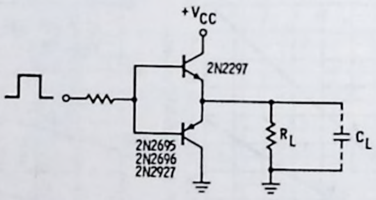
h PARAMETERS (f = 1kc)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance		480	1500	ohms	I_C = 10 mA V_{CE} = −10 V
h_{oe}	Output Conductance		80	1200	μmhos	I_C = 10 mA V_{CE} = −10 V
h_{re}	Voltage Feedback Ratio		162	2600	x10^{-6}	I_C = 10 mA V_{CE} = −10 V
h_{fe}	Small Signal Current Gain	25	74	180		I_C = 10 mA V_{CE} = −10 V

20mc BINARY COUNTER


V_{CC} = -2.5V
50
270
270
50
FD6
FD6
FD100
2N2695
2N2696
2N2927
FD100
FD100
2N2695
2N2696
2N2927
FD100
FD300
FD300
50
SINE WAVE INPUT
f = 20mcs

LINE DRIVER


+V_{CC}
2N2297
2N2695
2N2696
2N2927
R_L
C_L

Fairchild cannot assume responsibility for use of any circuitry described. No circuit patent licenses are implied.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

2N2845 · 2N2846 · 2N2847 · 2N2848

NPN HIGH-SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — The 2N2845, 2N2846, 2N2847, and 2N2848 are NPN double-diffused silicon PLANAR epitaxial transistors designed primarily for high-speed, 20–60 volt switching applications at collector currents up to 500 milliamperes. They are excellent drivers, featuring 20 nanosecond transition times for rod and magnetic memory, clock drivers for magnetic logic circuits, and general purpose circuitry. These devices are also useful as high frequency DC to DC converters.

ABSOLUTE MAXIMUM RATINGS [Note 1]

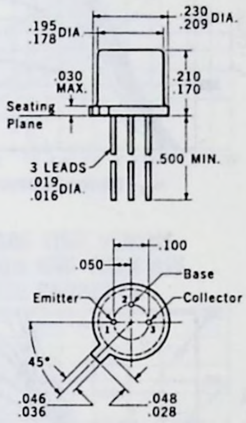
Maximum Temperatures

Storage Temperature	−65°C to +300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

Maximum Power Dissipation	**2N2845 2N2847**	**2N2846 2N2848**
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.2 Watts	3.0 Watts
at 100°C Case Temperature [Notes 2 and 3]	0.68 Watt	1.7 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.36 Watt	0.8 Watt

Maximum Voltages		**2N2845 2N2846**	**2N2847 2N2848**
V_{CBO}	Collector to Base Voltage	60 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	30 Volts	20 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

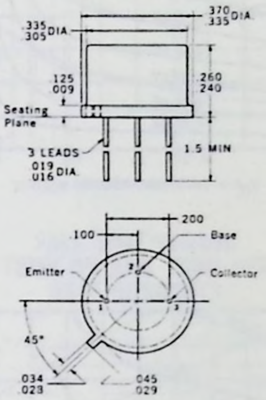
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

2N2845 · 2N2847

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2846 · 2N2848

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N2845 2N2846 Min.	Typ.	Max.	2N2847 2N2848 Min.	Typ.	Max.	Units	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 5]	30	60	120	40	60	140		$I_C = 150$ mA $V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	20	50		30	50			$I_C = 500$ mA $V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	10			10				$I_C = 500$ mA $V_{CE} = 1.0$ V
V_{CE} (sat)	Collector Saturation Voltage [pulsed, Note 5]		0.22	0.4		0.18	0.4	Volts	$I_C = 150$ mA $I_B = 15$ mA
V_{BE} (sat)	Base Saturation Voltage [pulsed, Note 5]		0.85	1.2		0.85	1.2	Volts	$I_C = 150$ mA $I_B = 15$ mA
V_{CE} (sat)	Collector Saturation Voltage [pulsed, Note 5]		0.48	1.0		0.4	0.75	Volts	$I_C = 500$ mA $I_B = 50$ mA
V_{BE} (sat)	Base Saturation Voltage [pulsed, Note 5]		1.1	1.6		1.1	1.6	Volts	$I_C = 500$ mA $I_B = 50$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5	3.5		2.5	3.5			$I_C = 50$ mA $V_{CE} = 10$ V
I_{CES}	Collector Reverse Current		0.04	0.2		0.04	0.2	μA	$V_{EB} = 0$ $V_{CE} = 30$ V
I_{CBO} (150°C)	Collector Cutoff Current		20	200		20	200	μA	$I_E = 0$ $V_{CB} = 30$ V
C_{obo}	Output Capacitance		6.0	8.0		6.0	8.0	pF	$I_C = 0$ $V_{CB} = 10$ V
T_{on}	Turn On Time [Note 6]		18	40		14	25	ns	$I_C \approx 150$ mA $I_{B1} \approx 15$ mA
T_{off}	Turn Off Time [Note 6]		25	40		20	40	ns	$I_C \approx 150$ mA, $I_{B1} \approx 15$ mA, $I_{B2} \approx -15$ mA
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			Volts	$I_C = 0.1$ mA $I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	30			20			Volts	$I_C = 30$ mA $I_B = 0$ (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_E = 0.1$ mA $I_C = 0$

NOTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt for the 2N2845 and 2N2847 (derating factor of 6.9 mW/°C); for the 2N2846 and 2N2848, 58.3°C/watt (derating factor of 17.2 mW/°C). Junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.1 mW/°C) for the 2N2845 and 2N2847; for the 2N2846 and 2N2848, 219°C/watt (derating factor of 4.6 mW/°C).
Rating refers to a high-current point where collector-to-emitter voltage is lowest.
Pulse Conditions: length = 300 μs ; duty cycle = 1%.
See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

* Planar is a patented Fairchild process.

FAIRCHILD
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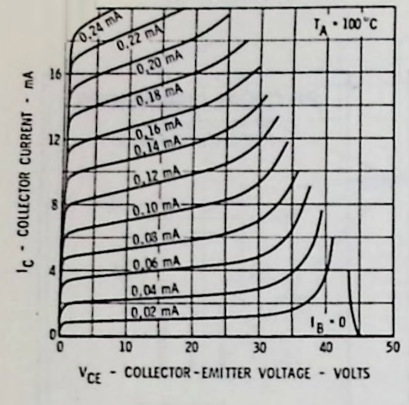
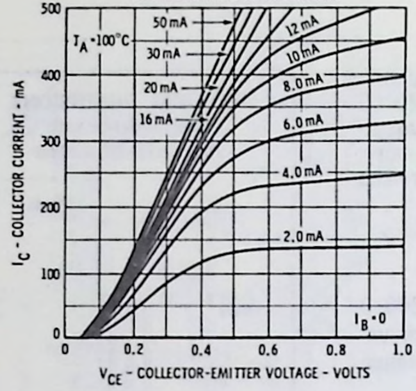
TYPICAL ELECTRICAL CHARACTERISTICS

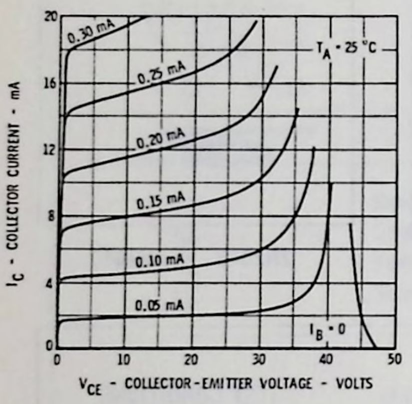
COLLECTOR CHARACTERISTICS*

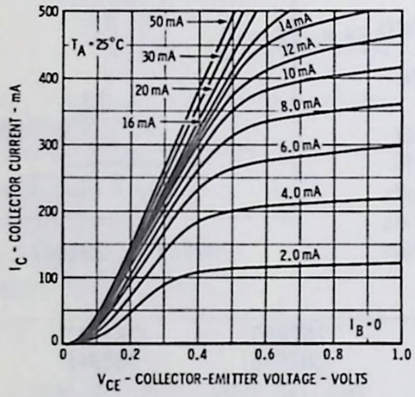
ACTIVE REGION

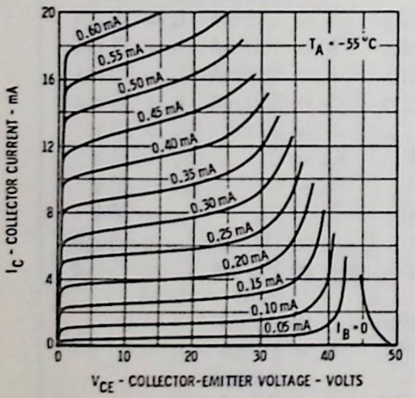


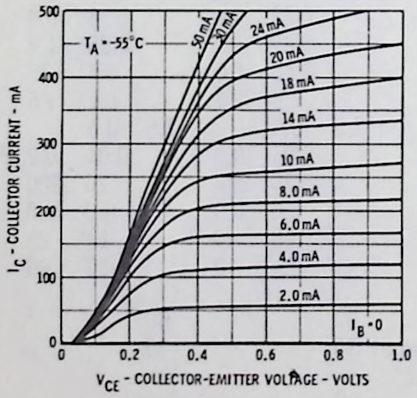
SATURATION REGION





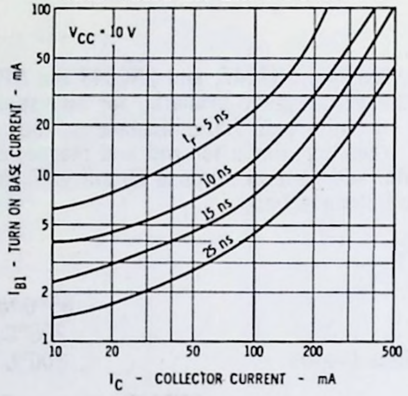




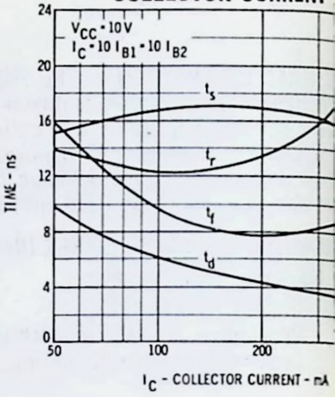


* Single family characteristics on Transistor Curve Tracer

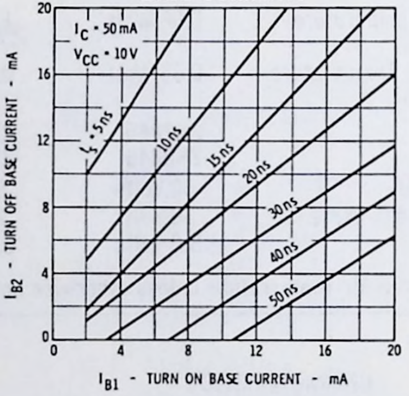
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



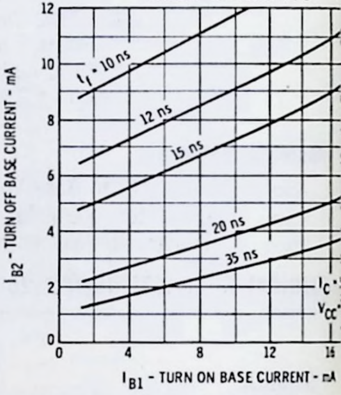
SWITCHING TIMES VERSU COLLECTOR CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OF BASE CURRENTS



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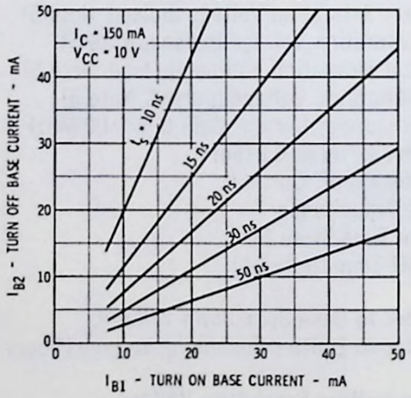
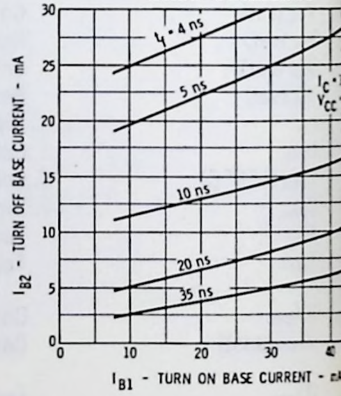
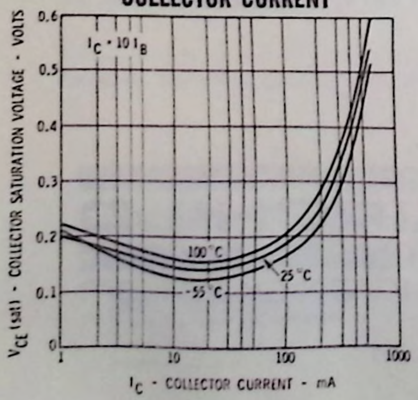


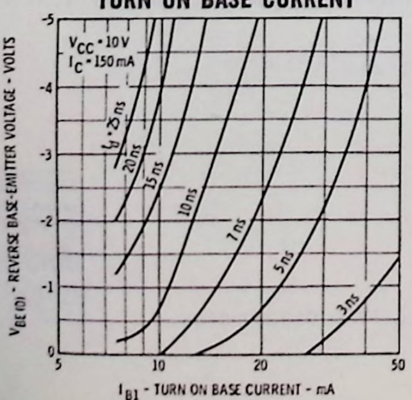
FALL TIME VERSUS TURN ON AND TURN OF BASE CURRENTS



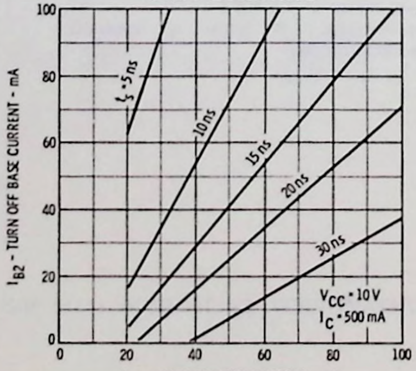
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



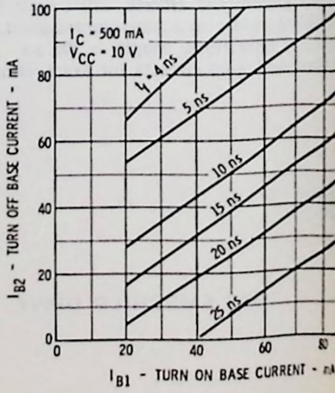
CONTOURS OF CONSTANT DELAY TIME VERSUS REVERSE BASE-EMITTER VOLTAGE AND TURN ON BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



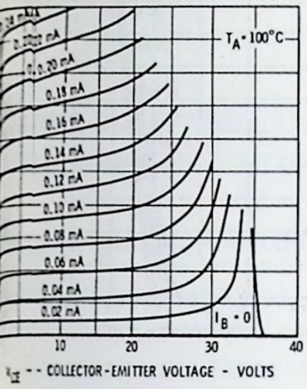
FALL TIME VERSUS TURN ON AND TURN OF BASE CURRENTS



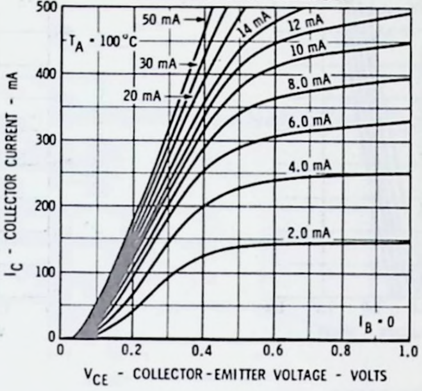
TYPICAL ELECTRICAL CHACTERISTICS

COLLECTOR CHARACTERISTICS*

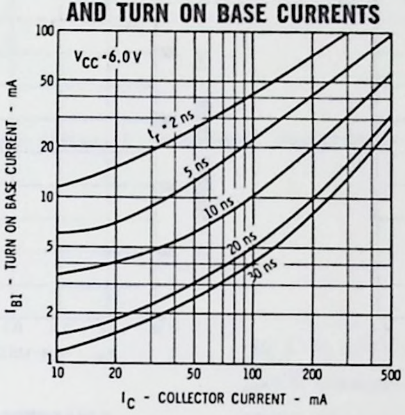
ACTIVE REGION



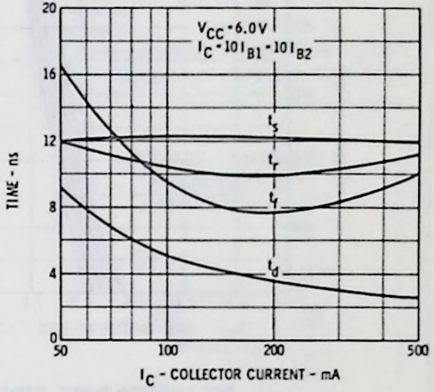
SATURATION REGION

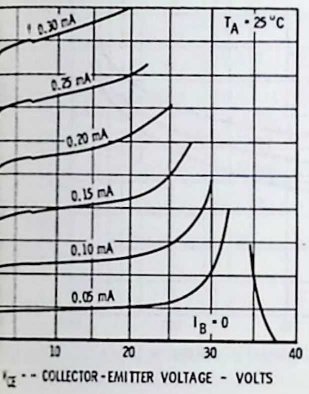


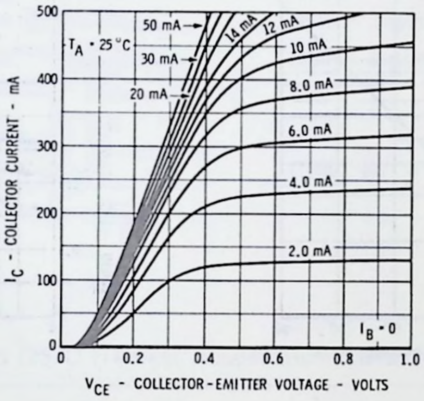
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



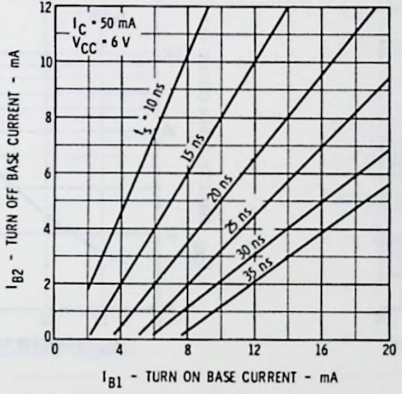
SWITCHING TIMES VERSUS COLLECTOR CURRENT



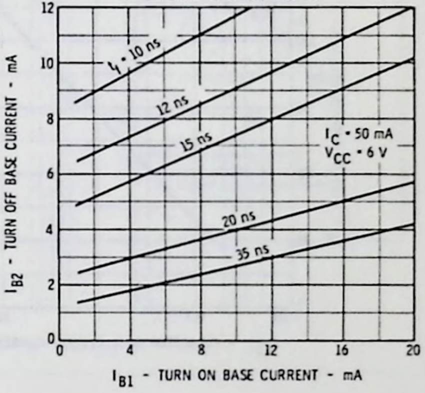


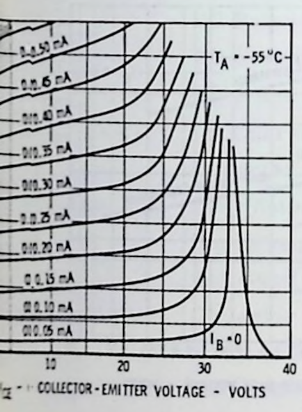


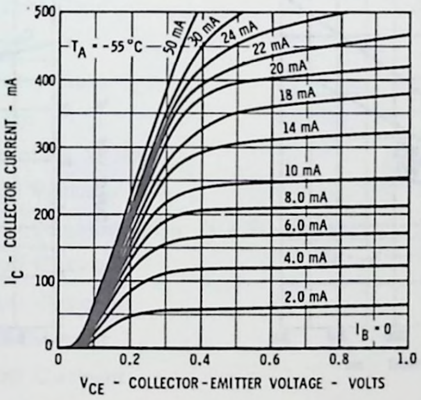
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



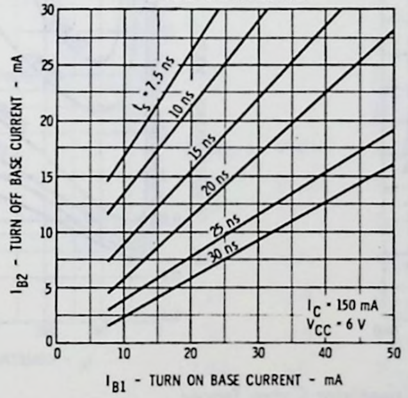
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



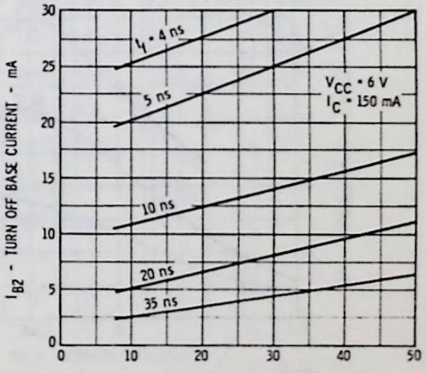




STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

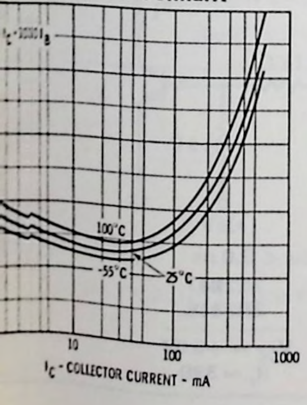


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

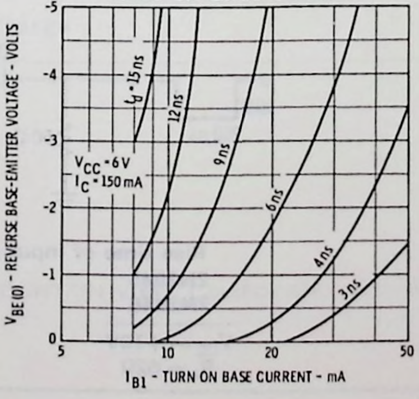


*Single family characteristics on Transistor Curve Tracer

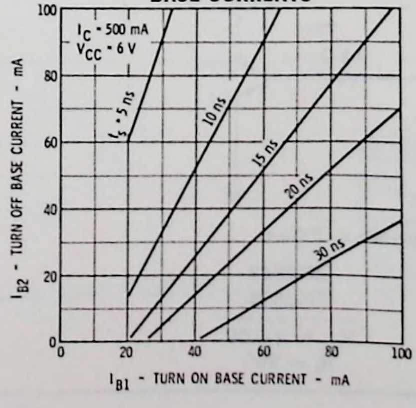
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



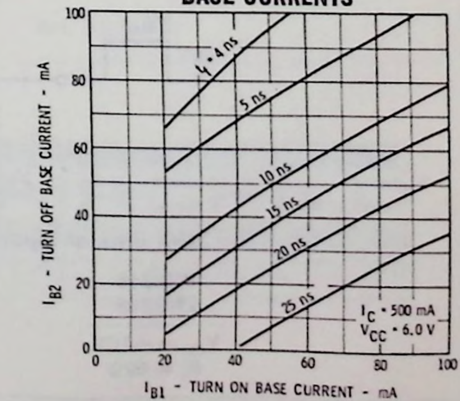
CONTOURS OF CONSTANT DELAY TIME VERSUS REVERSE BASE-EMITTER VOLTAGE AND TURN ON BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

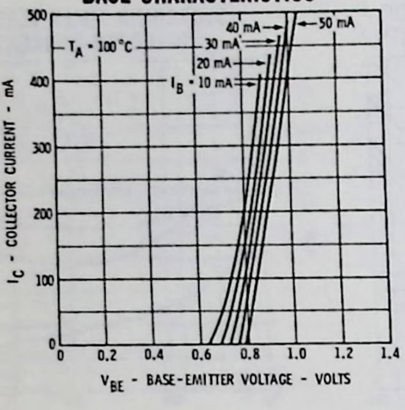


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

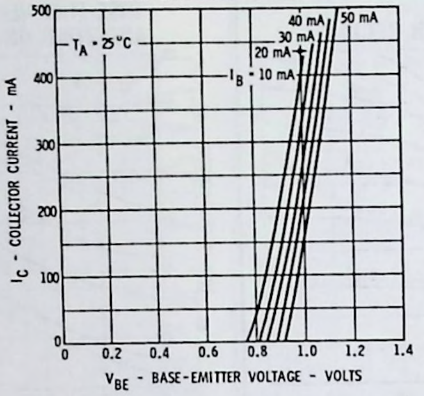


TYPICAL ELECTRICAL CHARACTERISTICS

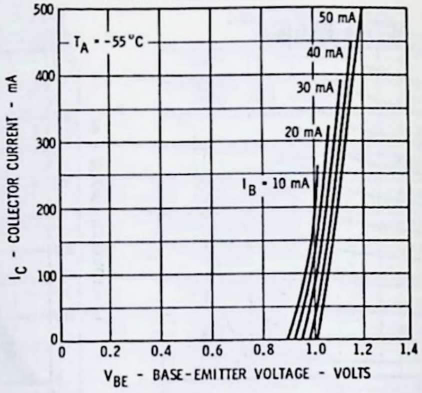
BASE CHARACTERISTICS*



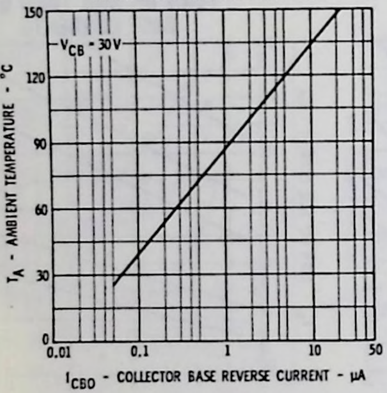
BASE CHARACTERISTICS*



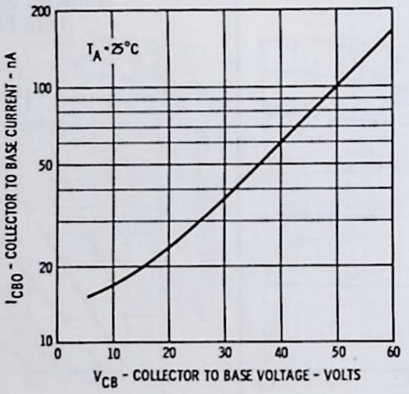
BASE CHARACTERISTICS*



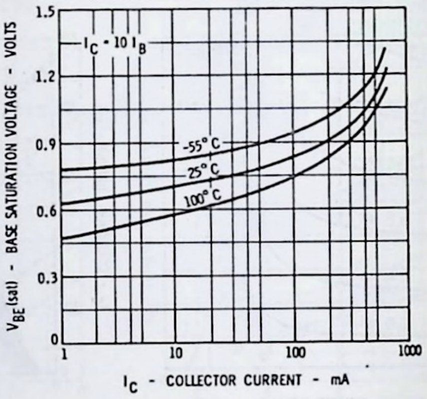
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



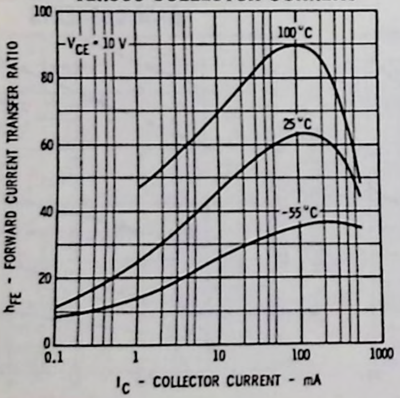
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



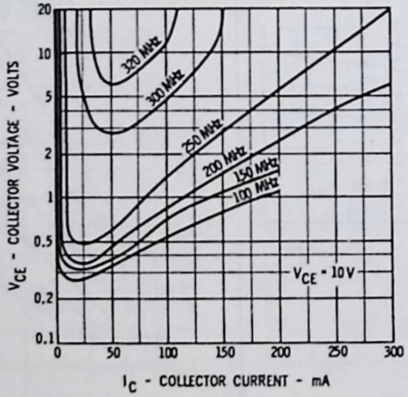
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



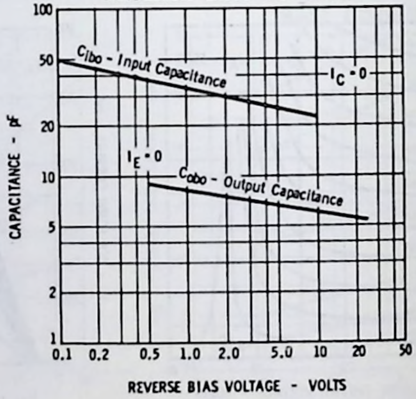
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

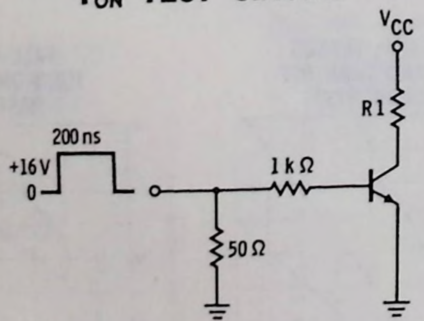


INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



* Single family characteristics on Transistor Curve Tracer

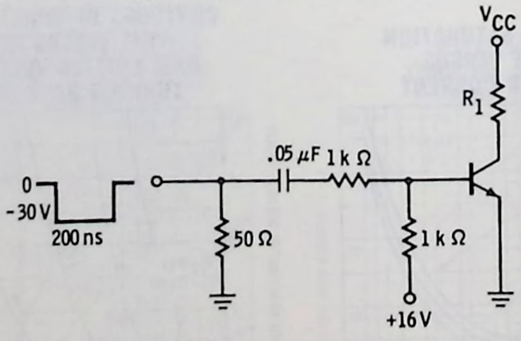
T_{ON} TEST CIRCUIT



Rise time of input pulse < 2.0 ns

2N2845 2N2846	2N2847 2N2848
$V_{CC} = +10V$ $R_l = 62\Omega$	$V_{CC} = +6.0V$ $R_l = 39\Omega$

T_{OFF} TEST CIRCUIT



Rise time of input pulse < 2.0 ns

2N2845 2N2846	2N2847 2N2848
$V_{CC} = +10V$ $R_l = 62\Omega$	$V_{CC} = +6.0V$ $R_l = 39\Omega$

2N2868

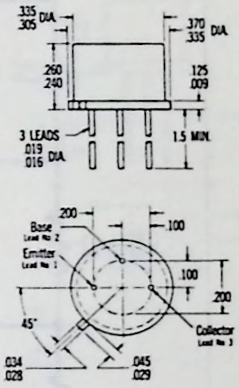
NPN HIGH-SPEED, HIGH-CURRENT SWITCH

SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE
SEE FAIRCHILD 2N3108, 2N3110

GENERAL DESCRIPTION - The Fairchild 2N2868 is an NPN silicon PLANAR epitaxial transistor designed for use in high-speed, high current switching applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
Storage Temperature			-65°C to +300°C
Operating Junction Temperature			200°C Maximum
Lead Temperature (Soldering, no time limit)			250°C Maximum
Maximum Power Dissipation			
Total Dissipation at 25°C Case Temperature		(Notes 2 and 3)	2.8 Watts
at 100°C Case Temperature		(Notes 2 and 3)	1.6 Watts
at 25°C Ambient Temperature		(Notes 2 and 3)	0.8 Watt
Maximum Voltages and Current			
V_{CBO}	Collector to Base Voltage		60 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts
I_C	Collector Current		1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	40	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	30			I_C = 150 mA	V_{CE} = 1.0 V
h_{FE}	DC Current Gain	30			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20			I_C = 500 mA	V_{CE} = 10 V
h_{FE}(-55°C)	DC Current Gain	20			I_C = 10 mA	V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage		0.25	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage		1.3	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 mc)	2.5			I_C = 50 mA	V_{CE} = 10 V
I_{CBO}	Collector Cutoff Current		10	nA	V_{CB} = 30 V	I_E = 0
I_{CBO}(150°C)	Collector Cutoff Current		15	μA	V_{CB} = 30 V	I_E = 0
I_{EBO}	Emitter Cutoff Current		50	nA	V_{EB} = 5.0 V	I_C = 0
I_{CEX}	Collector Cutoff Current		100	nA	V_{CE} = 30 V	V_{EB} = 3.0 V
I_{EBX}	Emitter Cutoff Current		100	nA	V_{CE} = 30 V	V_{EB} = 3.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	60		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40		Volts	I_C = 25 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		Volts	I_E = 100 μA	I_C = 0
C_{ob}	Output Capacitance (f = 1.0 mc)		20	pf	V_{CB} = 10 V	I_E = 0
τ_b	Base Stored Charge		2.0	μsec	See Figure I	

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NOTES:

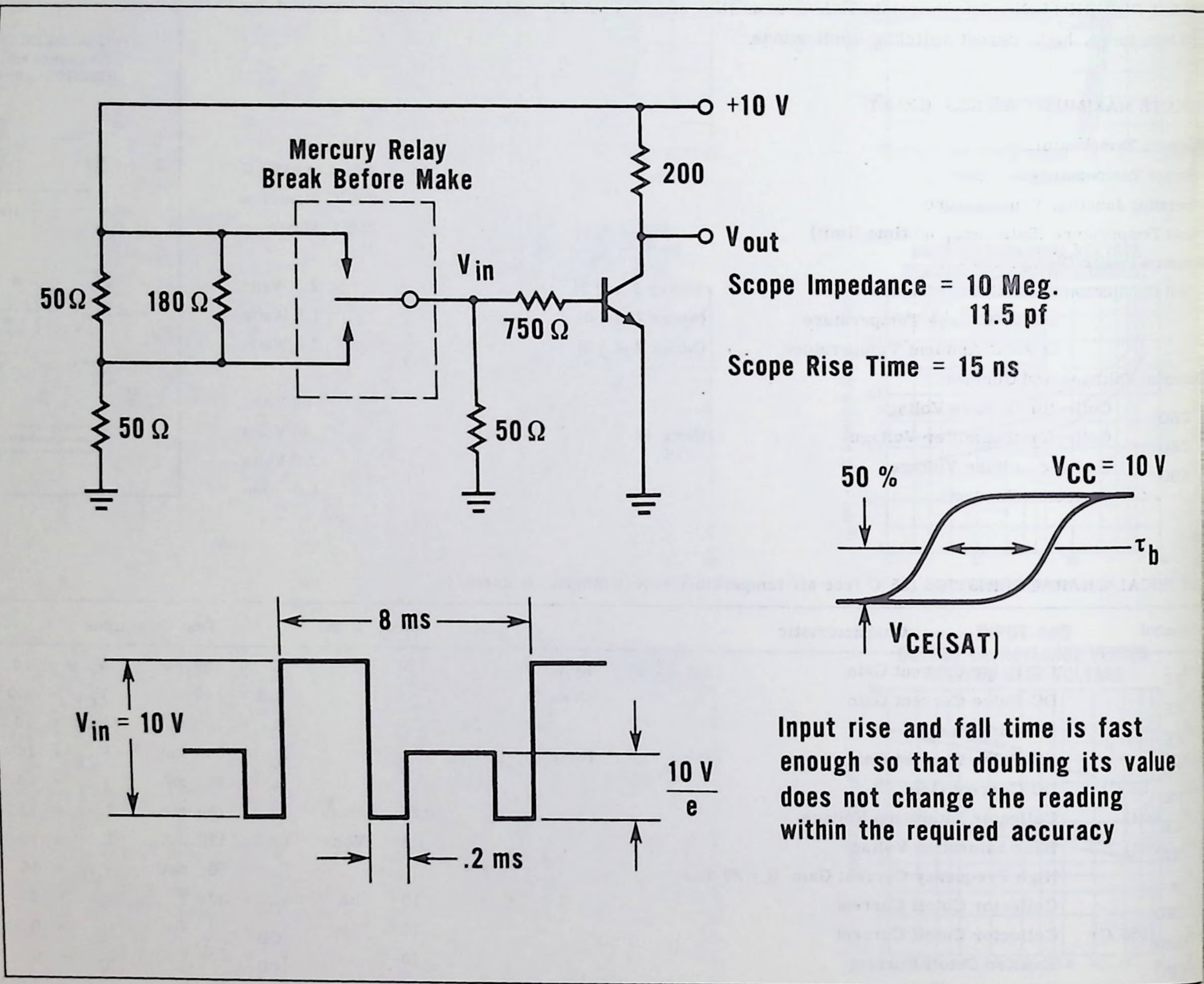
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 62.5°C/Watt (derating factor of 16 mW/°C); junction-t ambient thermal resistance of 218°C/Watt (derating factor of 4.6 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length ≤ 300 μsec; duty cycle ≤ 2%.



+10 V
Mercury Relay
Break Before Make
200
V out
V in
50Ω
180 Ω
750 Ω
50 Ω
50 Ω
Scope Impedance = 10 Meg.
11.5 pf
Scope Rise Time = 15 ns
50 %
V CC = 10 V
τ b
V CE(SAT)
8 ms
V in = 10 V
10 V
e
.2 ms
Input rise and fall time is fast enough so that doubling its value does not change the reading within the required accuracy

FIGURE 1

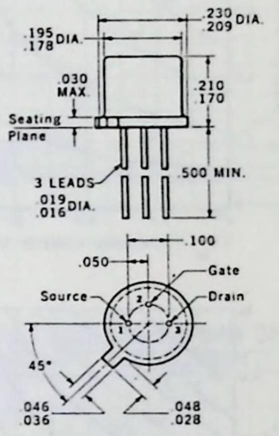
2N2894

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

The **2N2894** is a 600 MHz PNP silicon PLANAR* epitaxial transistor designed for saturated and non-saturated switching circuits requiring up to 200 milliamperes of collector current. It is suitable for 20 MHz RF amplifiers, 10.7 MHz IF amplifiers, and 100 MHz oscillator converter circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Gate internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.2 Watts
at 100°C Case Temperature [Notes 2 and 3]	0.72 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.36 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	−12 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	−12 Volts
V_{EBO} Emitter to Base Voltage	−4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 5]	40	75	150		$I_C = 30$ mA $V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	55			$I_C = 10$ mA $V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	25				$I_C = 100$ mA $V_{CE} = -1.0$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	17	43			$I_C = 30$ mA $V_{CE} = -0.5$
V_{CE} (sat)	Collector-Emitter Saturation Voltage		−0.07	−0.15	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage		−0.1	−0.2	Volts	$I_C = 30$ mA $I_B = 3.0$ mA
V_{CE} (sat)	Collector-Emitter Saturation Voltage		−0.25	−0.5	Volts	$I_C = 100$ mA $I_B = 10$ mA
V_{BE} (sat)	Base-Emitter Saturation Voltage	−0.78	−0.92	−0.98	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{BE} (sat)	Base-Emitter Saturation Voltage	−0.85	−1.1	−1.2	Volts	$I_C = 30$ mA $I_B = 3.0$ mA
V_{BE} (sat)	Base-Emitter Saturation Voltage		−1.4	−1.7	Volts	$I_C = 100$ mA $I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	4.0	5.5			$I_C = 30$ mA $V_{CE} = -10$ V
C_{ob}	Output Capacitance		3.3	6.0	pf	$V_{CB} = -5.0$ V $I_E = 0$
C_{TE}	Emitter Transition Capacitance		3.8	6.0	pf	$V_{EB} = -0.5$ V $I_C = 0$
I_{CES}	Collector Reverse Current		0.05	80	nA	$V_{CE} = -6.0$ V $V_{EB} = 0$
I_{CBO} (125°C)	Collector Cutoff Current		0.025	10	μA	$V_{CB} = -6.0$ V $I_E = 0$
V_{CEO} (sust)	Collector-Emitter Sustaining Voltage [Notes 4 and 5]	−12			Volts	$I_C = 10$ mA $I_B = 0$ (pulsed)
BV_{CBO}	Collector-Base Breakdown Voltage	−12			Volts	$I_C = 10$ μA $I_E = 0$
BV_{EBO}	Emitter-Base Breakdown Voltage	−4.0			Volts	$I_E = 100$ μA $I_C = 0$
T_{ON}	Turn On Time [Note 6]		23	60	nsec	$I_C \approx 30$ mA $I_{B1} \approx 1.5$ mA
T_{OFF}	Turn Off Time [Note 6]		34	90	nsec	$I_C \approx 30$ mA, $I_{B1} \approx 1.5$ mA, $I_{B2} \approx -1.5$ mA

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C); junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C.)
(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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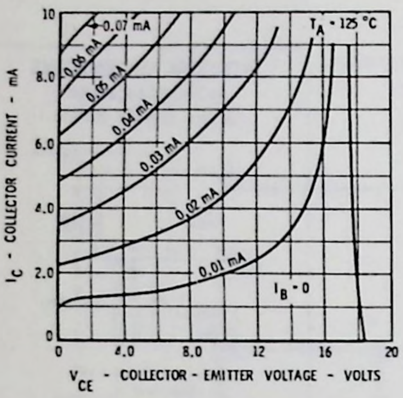
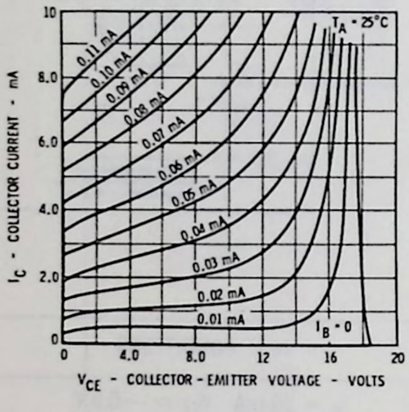
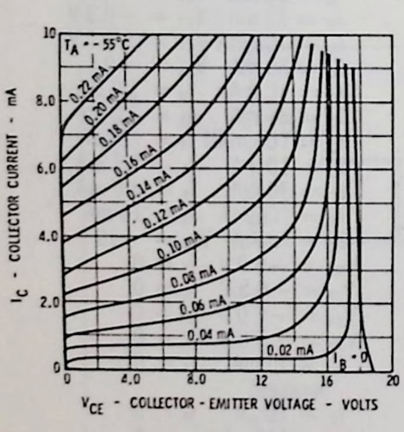
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

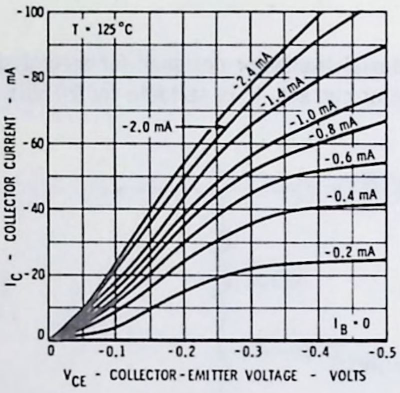
ACTIVE REGION

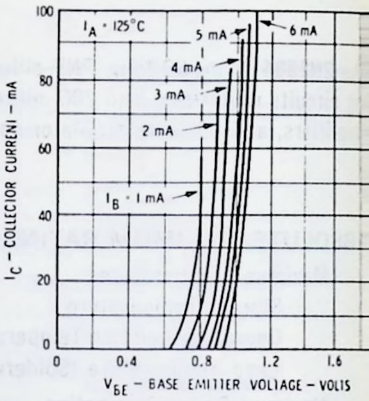


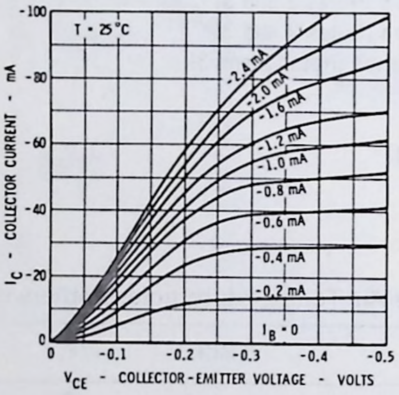


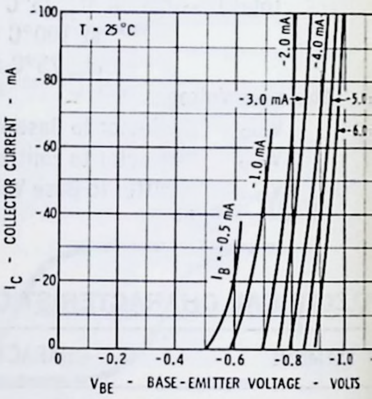


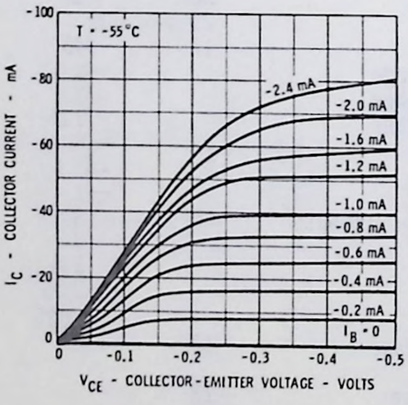
SATURATION REGION

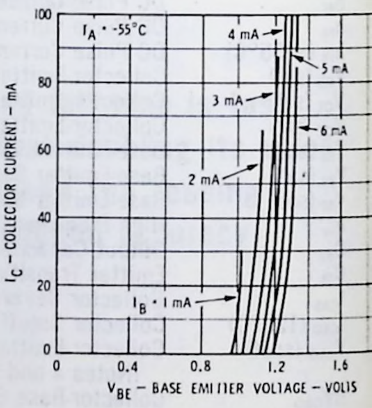








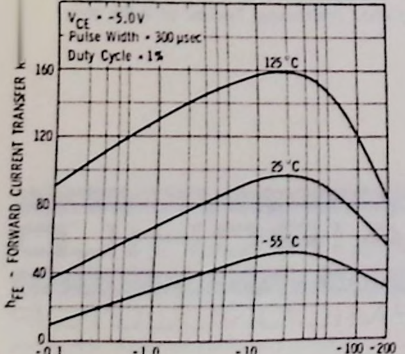




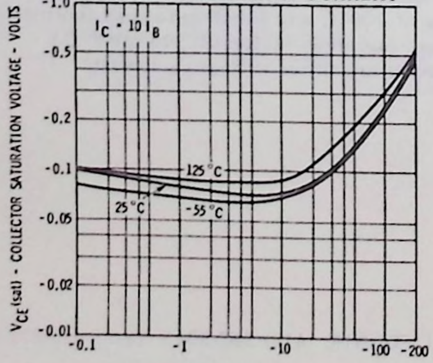
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

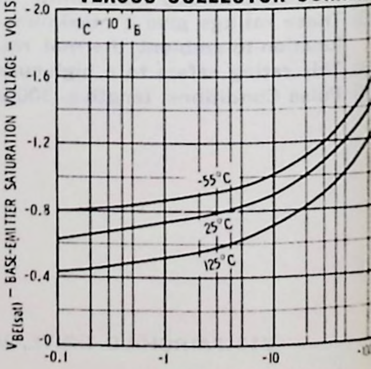
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

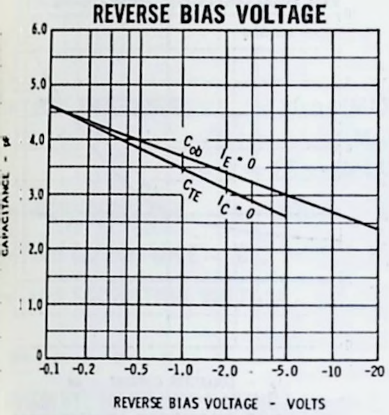


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

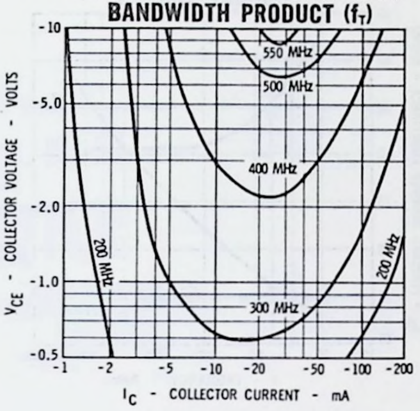


TYPICAL ELECTRICAL CHARACTERISTICS

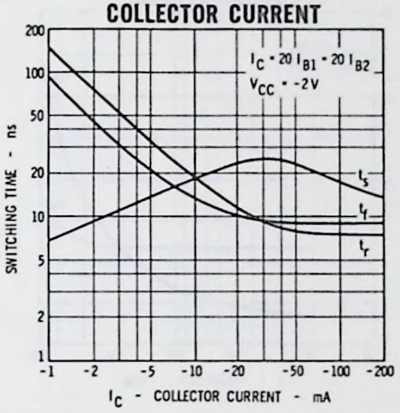
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



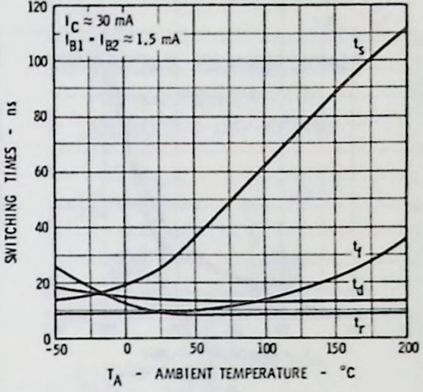
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



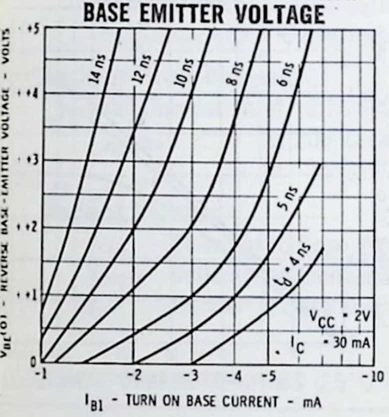
SWITCHING TIMES VERSUS COLLECTOR CURRENT



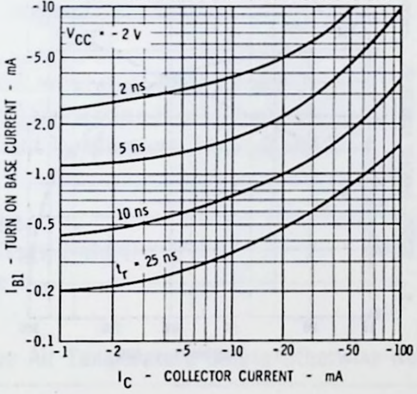
SWITCHING TIMES VERSUS TEMPERATURE



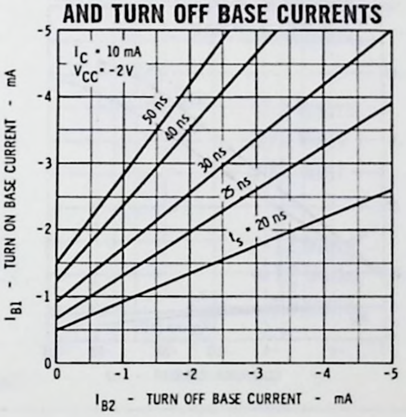
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



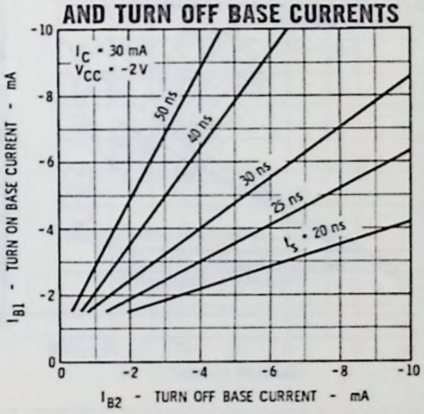
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



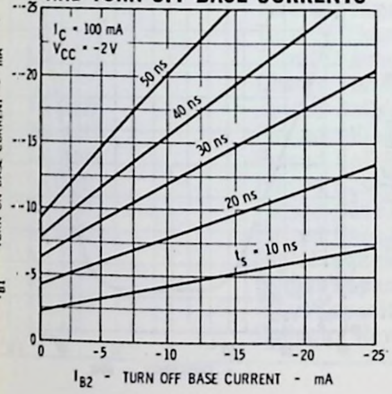
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



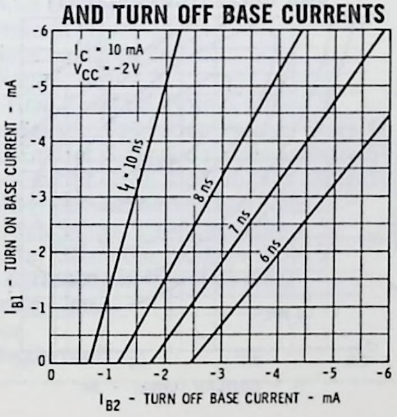
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



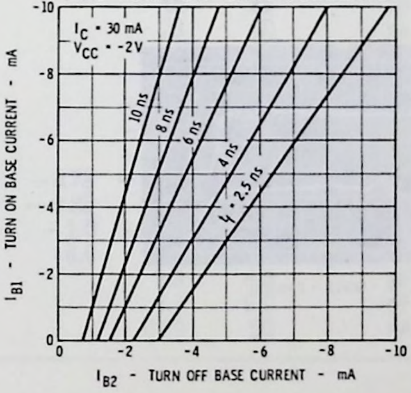
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



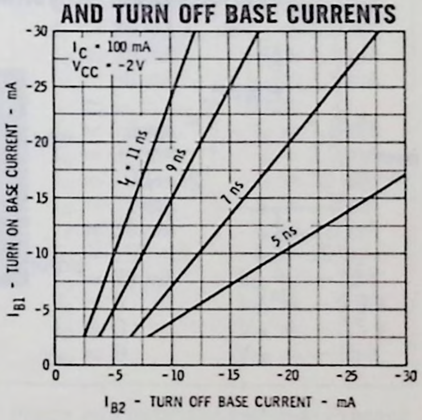
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



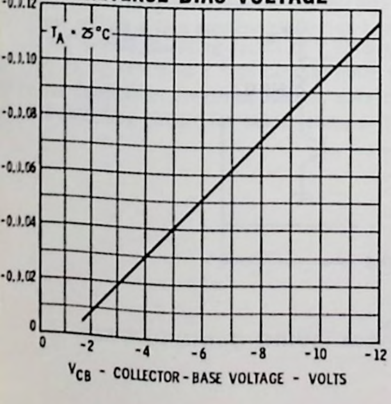
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



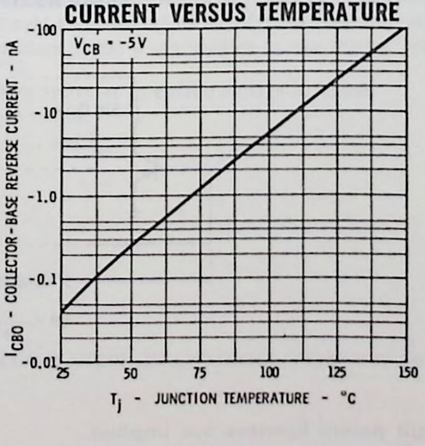
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



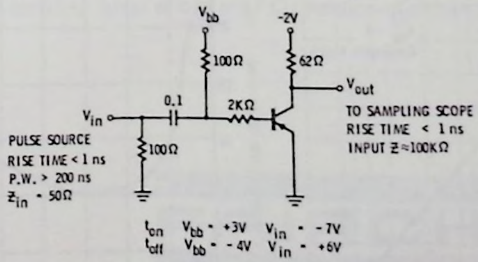
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE

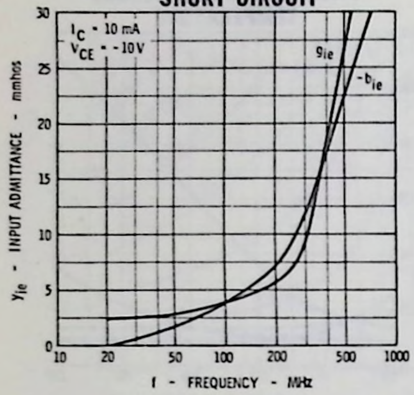


SWITCHING TIME TEST CIRCUIT

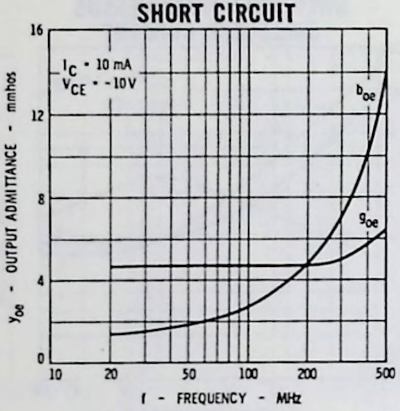

V_{bb}
100Ω
-2V
62Ω
V_{out}
TO SAMPLING SCOPE
RISE TIME < 1 ns
INPUT Z ≈ 100KΩ
V_{in}
0.1
2KΩ
PULSE SOURCE
RISE TIME < 1 ns
P.W. > 200 ns
$Z_{in} = 50Ω$
100Ω
t_{on} $V_{bb} = +3V$ $V_{in} = -7V$
t_{off} $V_{bb} = -4V$ $V_{in} = +6V$

TYPICAL COMMON EMITTER "Y" PARAMETERS

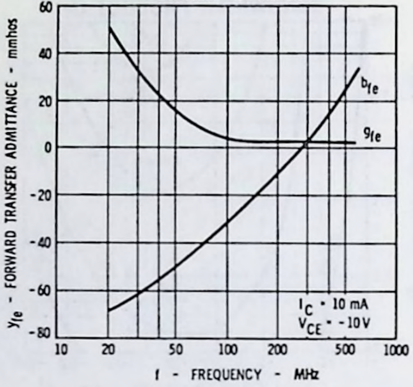
INPUT ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



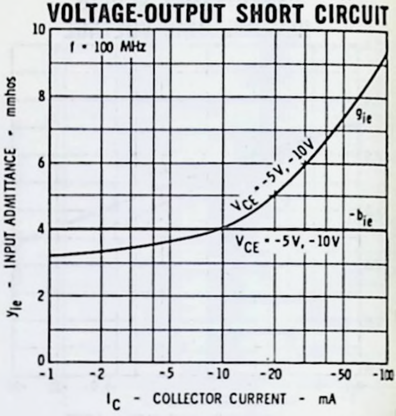
OUTPUT ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



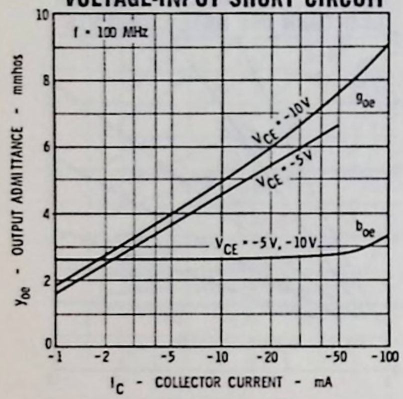
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



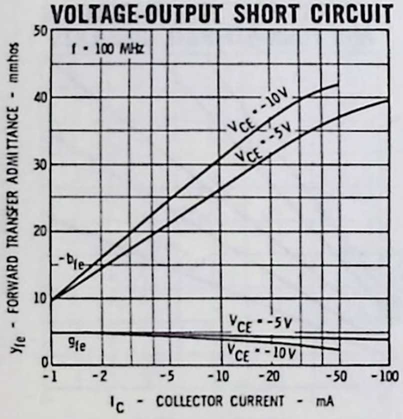
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



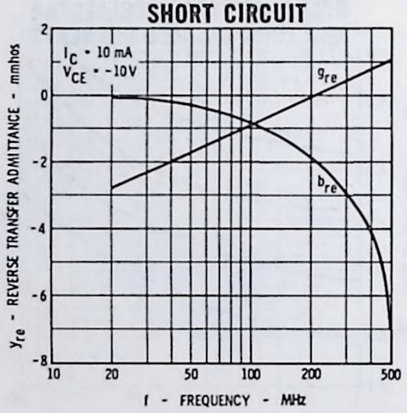
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



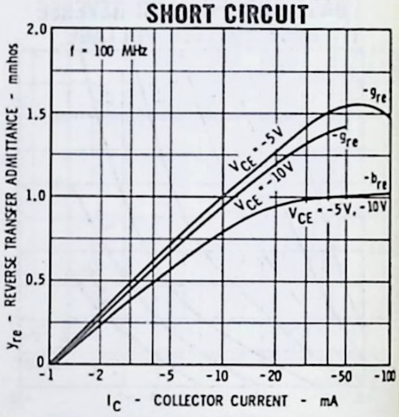
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



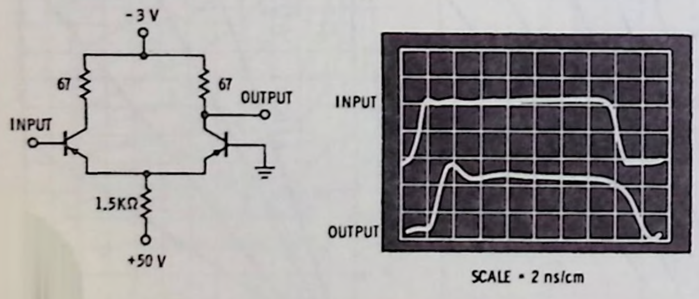
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT

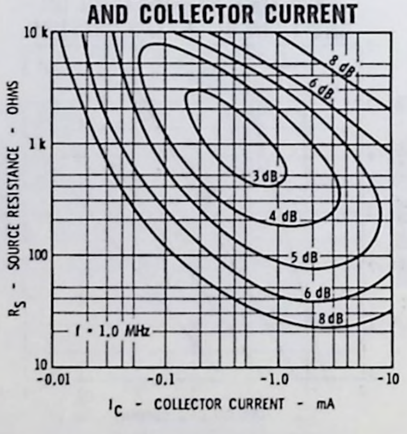


NON SATURATED SWITCHING PERFORMANCE

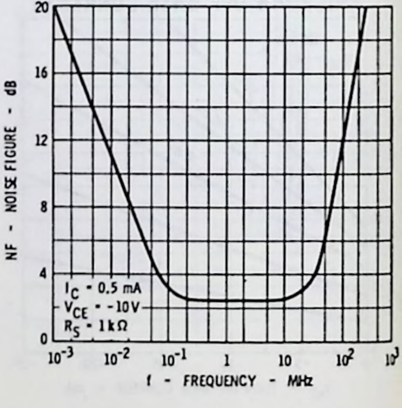


SCALE = 2 ns/cm

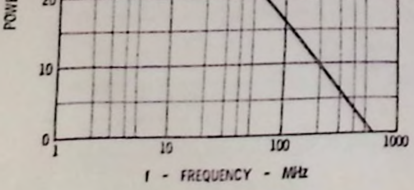
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



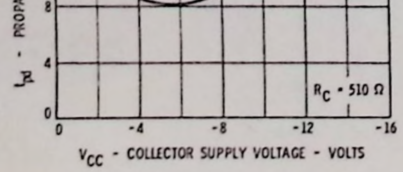
NOISE FIGURE VERSUS FREQUENCY



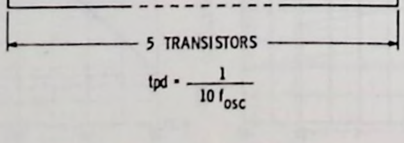
DEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY



Fairchild cannot assume responsibility for use of any circuitry described. No circuit patent licenses are implied.

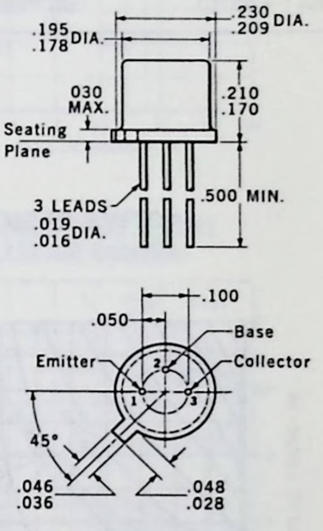
2N2894A

PNP HIGH SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTOR

- **FAST SWITCHING** -- t_{on} = 20 ns (MAX)
  -- t_{off} = 25 ns (MAX)
  -- τ_s = 20 ns (MAX)
- **HIGH FREQUENCY** -- f_T = 800 MHz (MIN)
- **LOW CAPACITANCE** -- C_{obo} = 4.5 pF (MAX)
- **LOW SATURATION VOLTAGE** -- $V_{CE(SAT)}$ = 0.13 V (MAX) @ I_C = 10 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.44 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.2 Watts
at 100°C Case Temperature [Notes 2 and 3]	0.72 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.36 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	−12 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	−12 Volts
V_{EBO} Emitter to Base Voltage	−4.5 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions	
t_{on}	**Turn On Time** [Note 6, Figure 1]		**10**	**20**	**ns**	**$I_C \approx$ 30 mA**	**$I_{B1} \approx$ 3.0 mA**
t_{off}	**Turn Off Time** [Note 6, Figure 1]		**15**	**25**	**ns**	**$I_C \approx$ 30 mA $I_{B1} \approx I_{B2} \approx$ 3.0 mA**	
t_{on}	Turn On Time [Note 6, Figure 2]		23	60	ns	$I_C \approx$ 30 mA	$I_{B1} \approx$ 1.5 mA
t_{off}	Turn Off Time [Note 6, Figure 2]		13	35	ns	$I_C \approx$ 30 mA $I_{B1} \approx I_{B2} \approx$ 1.5 mA	
τ_s	**Charge Storage Time Constant** [Note 6, Figure 3]		**15**	**20**	**ns**	**$I_C \approx I_{B1} \approx I_{B2} \approx$ 10 mA**	
V_{CE}(sat)	**Pulsed Collector-Emitter Saturation Voltage** [Note 5]		**−0.08**	**−0.13**	**Volts**	**I_C = 10 mA**	**I_B = 1.0 mA**
V_{CE}(sat)	Pulsed Collector-Emitter Saturation Voltage [Note 5]		−0.12	−0.19	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{CE}(sat)	Pulsed Collector-Emitter Saturation Voltage [Note 5]		−0.28	−0.45	Volts	I_C = 100 mA	I_B = 10 mA
V_{BE}(sat)	Pulsed Base-Emitter Saturation Voltage [Note 5]	−0.78	−0.82	−0.92	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Pulsed Base-Emitter Saturation Voltage [Note 5]	−0.85	−0.93	−1.15	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{BE}(sat)	Pulsed Base-Emitter Saturation Voltage [Note 5]	−1.0	−1.14	−1.5	Volts	I_C = 100 mA	I_B = 10 mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**8.0**	**12**			**I_C = 30 mA**	**V_{CE} = −10 V**
C_{obo}	**Output Capacitance**		**3.3**	**4.5**	**pF**	**I_E = 0**	**V_{CB} = −5.0 V**
C_{ibo}	Input Capacitance		4.7	6.0	pF	I_C = 0	V_{EB} = −0.5 V
I_{CES}	Collector Reverse Current		0.29	50	nA	V_{BE} = 0	V_{CE} = −10 V

* Planar is a patented Fairchild Process.

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).
This rating refers to a high current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.
See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

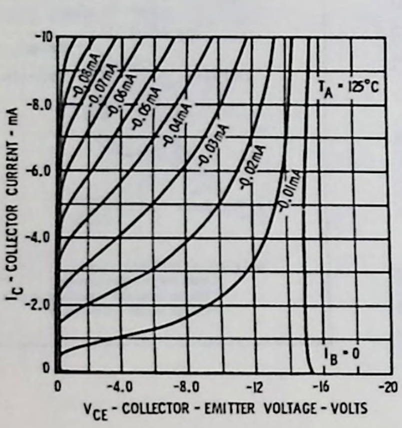
FAIRCHILD TRANSISTOR 2N2894A

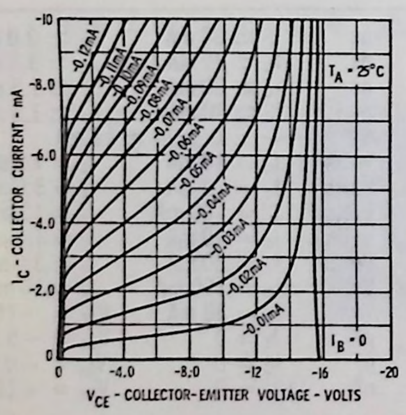
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

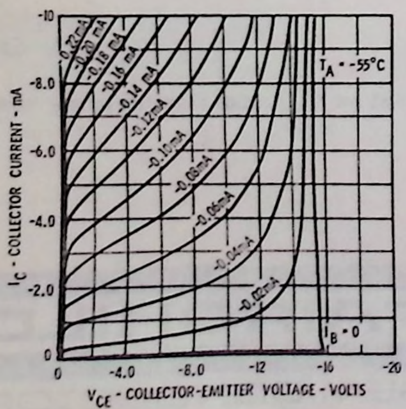
Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions	
I_{CBO} (125°C)	Collector Cutoff Current		0.05	10	μA	$I_E = 0$	$V_{CB} = -10$ V
V_{CEO} (sust)	**Collector-Emitter Sustaining Voltage** [Notes 4 and 5]	**−12**			**Volts**	**$I_C = 10$ mA** (pulsed)	**$I_B = 0$**
BV_{CBO}	Collector-Base Breakdown Voltage	−12			Volts	$I_C = 10\ \mu$A	$I_E = 0$
BV_{CES}	Collector-Emitter Breakdown Voltage	−12			Volts	$I_C = 10\ \mu$A	$V_{BE} = 0$
BV_{EBO}	Emitter-Base Breakdown Voltage	−4.5			Volts	$I_C = 0$	$I_E = 100\ \mu$A
h_{FE}	DC Pulse Current Gain [Note 5]	20	44			$I_C = 1.0$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	53			$I_C = 10$ mA	$V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	40	63	120		$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	**DC Pulse Current Gain [Note 5]**	**30**	**55**			**$I_C = 100$ mA**	**$V_{CE} = -1.0$ V**
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	20	38			$I_C = 30$ mA	$V_{CE} = -0.5$ V

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

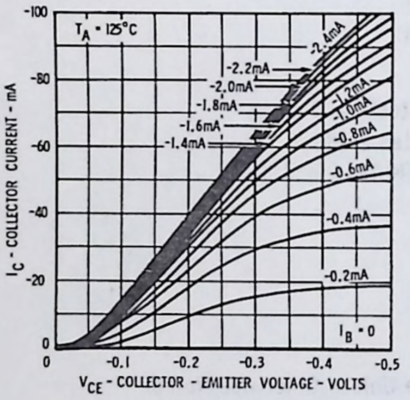
ACTIVE REGION

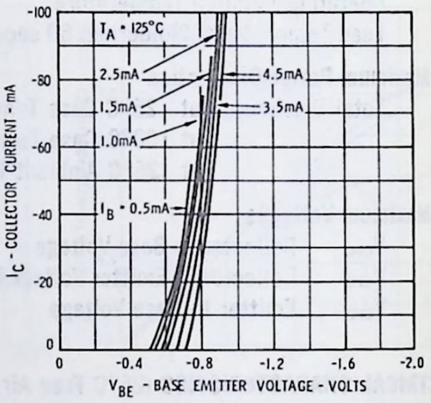


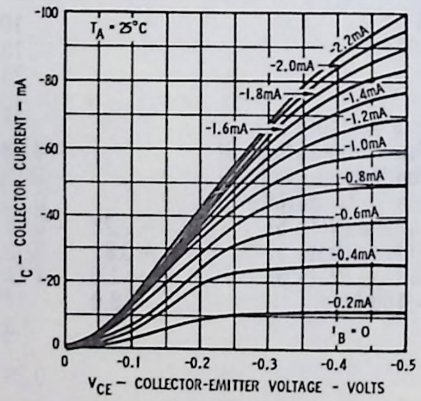


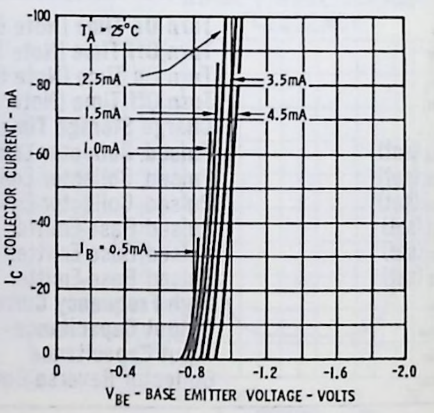


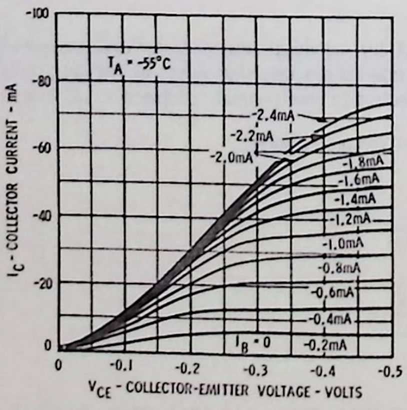
SATURATION REGION

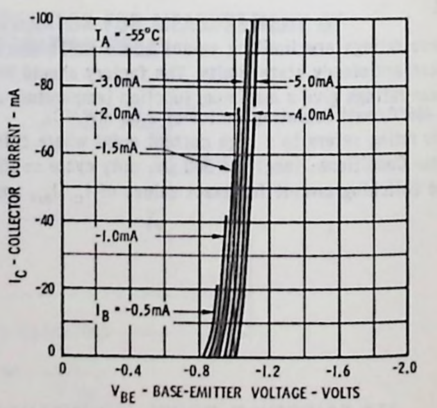








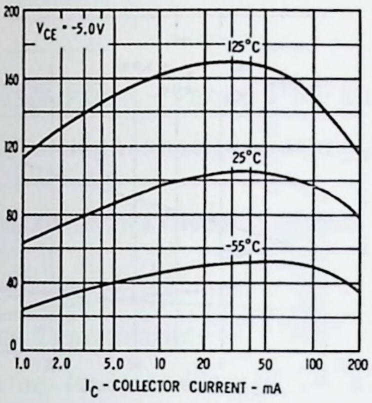




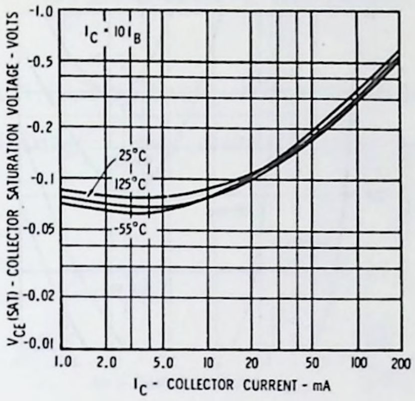
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

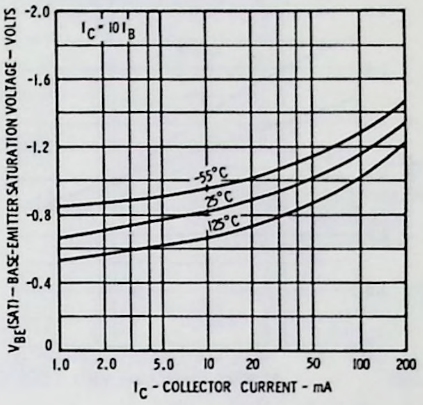
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



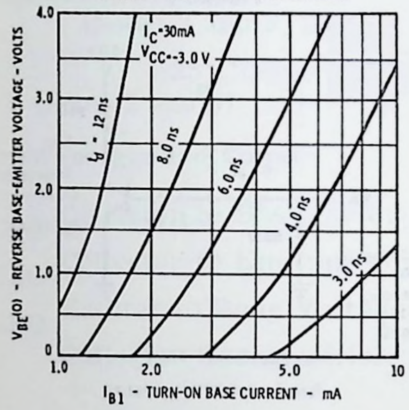
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



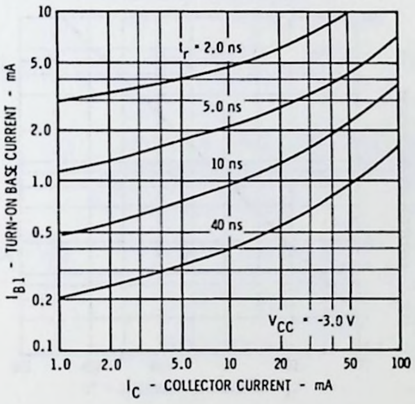
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



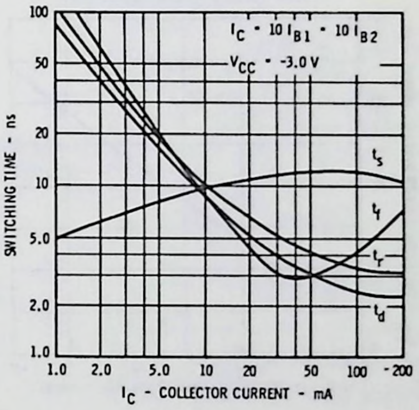
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



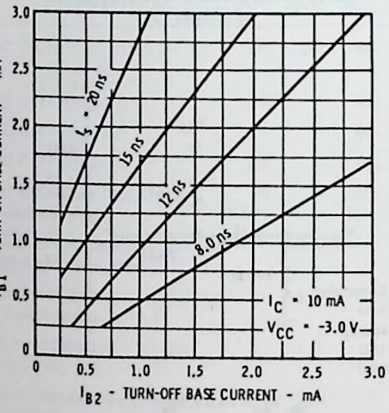
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



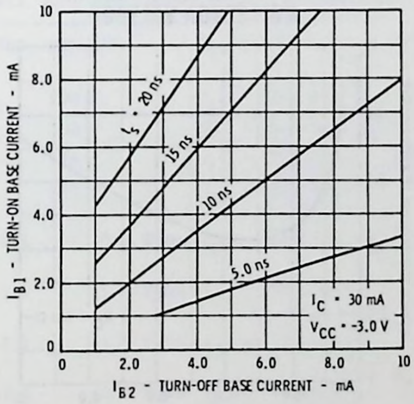
SWITCHING TIMES VERSUS COLLECTOR CURRENT



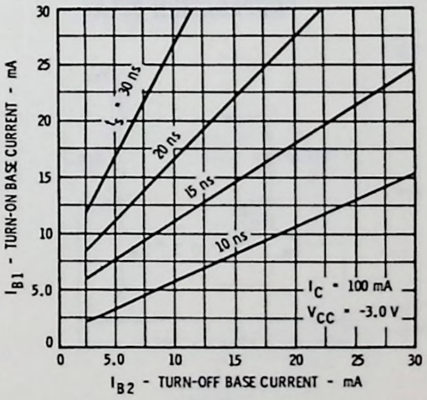
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



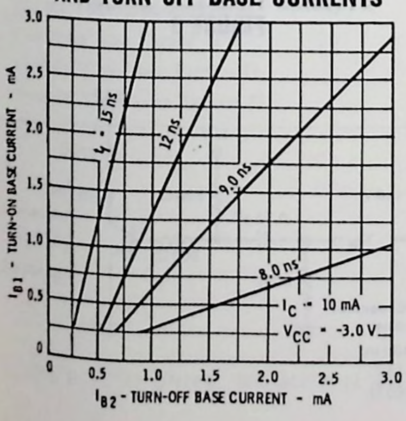
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



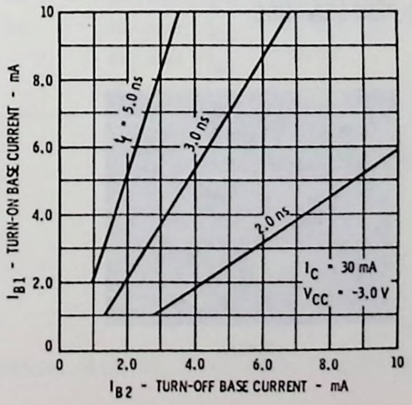
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



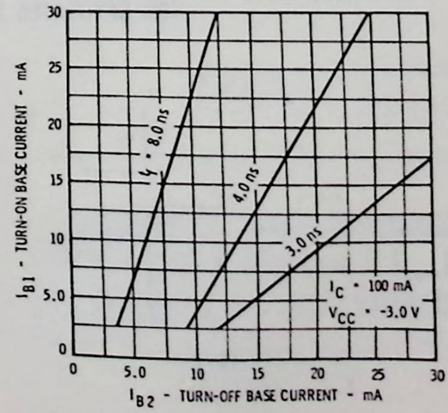
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

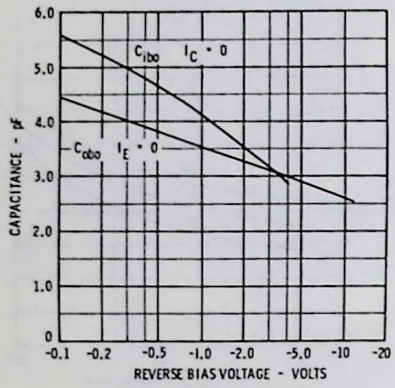


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

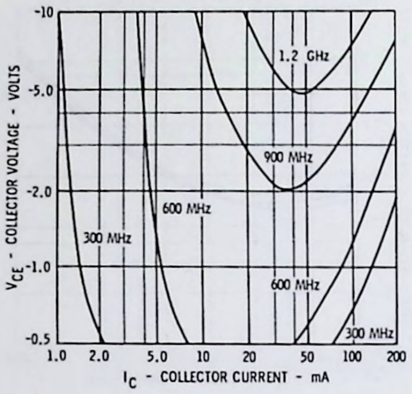


TYPICAL ELECTRICAL CHARACTERISTICS

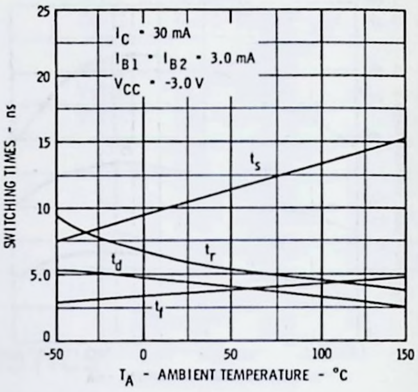
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



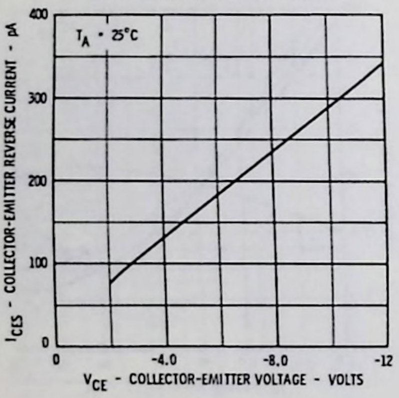
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



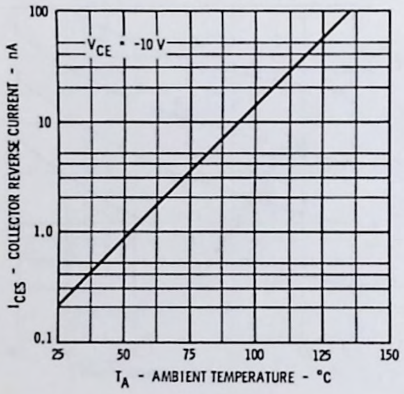
SWITCHING TIMES VERSUS TEMPERATURE



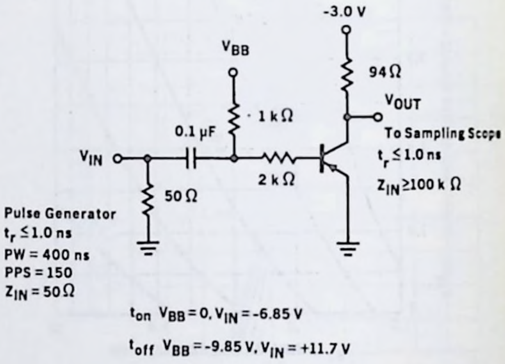
COLLECTOR-EMITTER REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



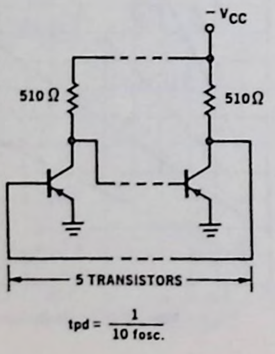
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



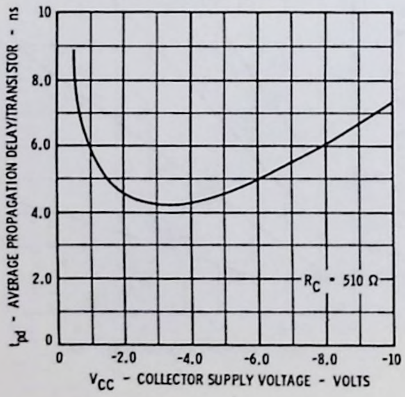
SWITCHING TIME TEST CIRCUIT FIGURE 1


-3.0 V
V_{BB}
94 Ω
V_{OUT}
1 kΩ
0.1 µF
To Sampling Scope
t_r ≤ 1.0 ns
Z_{IN} ≥ 100 k Ω
V_{IN}
2 kΩ
50 Ω
Pulse Generator
t_r ≤ 1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω
t_{on} V_{BB} = 0, V_{IN} = -6.85 V
t_{off} V_{BB} = -9.85 V, V_{IN} = +11.7 V

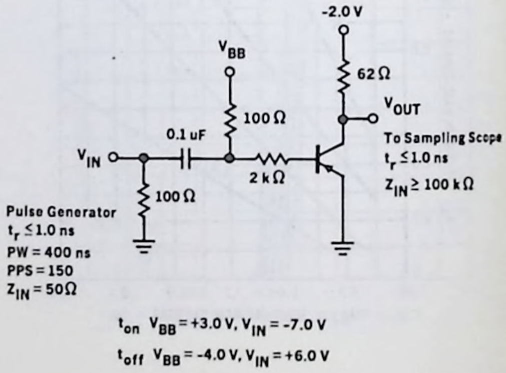
FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY


- V_{CC}
510 Ω
510 Ω
5 TRANSISTORS
tpd = $\frac{1}{10 \text{ fosc.}}$

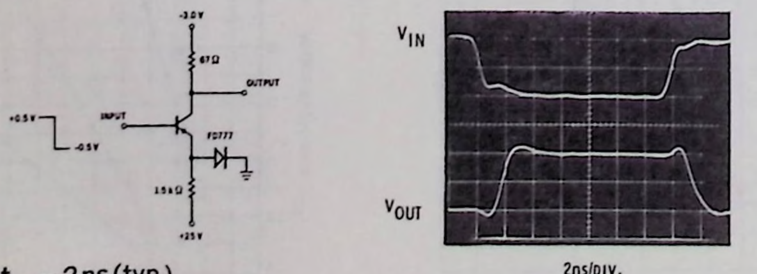
AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE



SWITCHING TIME TEST CIRCUIT FIGURE 2

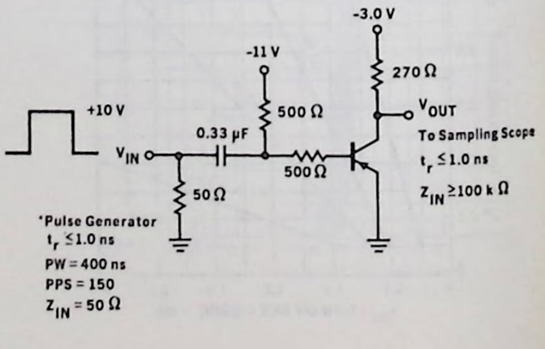

-2.0 V
V_{BB}
62 Ω
V_{OUT}
100 Ω
0.1 uF
To Sampling Scope
t_r ≤ 1.0 ns
Z_{IN} ≥ 100 k Ω
V_{IN}
2 kΩ
100 Ω
Pulse Generator
t_r ≤ 1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω
t_{on} V_{BB} = +3.0 V, V_{IN} = -7.0 V
t_{off} V_{BB} = -4.0 V, V_{IN} = +6.0 V

NON SATURATED SWITCHING PERFORMANCE


-3.0 V
67 Ω
OUTPUT
INPUT
+0.5 V
-0.5 V
FD777
1.5 kΩ
+25 V
V_{IN}
V_{OUT}
2ns/DIV.

$t_{on} = 2$ ns (typ.)
$t_{off} = 2$ ns (typ.)

STORAGE TIME TEST CIRCUIT FIGURE 3


-3.0 V
-11 V
270 Ω
+10 V
500 Ω
V_{OUT}
0.33 µF
To Sampling Scope
V_{IN}
500 Ω
t_r ≤ 1.0 ns
50 Ω
Z_{IN} ≥ 100 k Ω
*Pulse Generator
t_r ≤ 1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω

2N2904 · 2N2905 · 2N2906 · 2N2907
2N2904A · 2N2905A · 2N2906A · 2N2907A
PNP HIGH-SPEED SWITCHES AND CORE DRIVERS
SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - These PNP silicon PLANAR epitaxial transistors are designed primarily for high-speed saturated switching and core driver applications.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	200°C Maximum

Maximum Power Dissipation

	2N2904 2N2904A 2N2905 2N2905A	2N2906 2N2906A 2N2907 2N2907A
Total Dissipation @ 25°C Case Temperature (Notes 2 and 3)	3.0 Watts	1.8 Watts
@25°C Free Air Temperature (Notes 2 and 3)	0.6 Watt	0.4 Watt

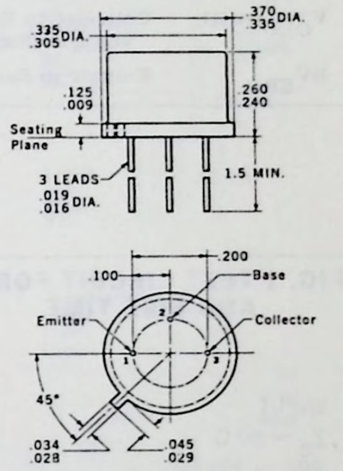
Maximum Voltages and Current

		2N2904 2N2906 2N2905 2N2907	2N2904A 2N2906A 2N2905A 2N2907A
V_{CBO}	Collector to Base Voltage	-60 Volts	-60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-40 Volts	-60 Volts
V_{EBO}	Emitter to Base Voltage	-5.0 Volts	-5.0 Volts
I_C	Collector Current (Note 2)	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N2904 2N2906		2N2904A 2N2906A		2N2905 2N2907		2N2905A 2N2907A				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	40	120	100	300	100	300		I_C = 150 mA	V_{CE} = -10 V
h_{FE}	DC Current Gain	35		40		75		100			I_C = 10 mA	V_{CE} = -10 V
h_{FE}	DC Current Gain	25		40		50		100			I_C = 1.0 mA	V_{CE} = -10 V
h_{FE}	DC Current Gain	20		40		35		75			I_C = 0.1 mA	V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20		40		30		50			I_C = 500 mA	V_{CE} = -10 V
V_{CE}(sat)	Collector Saturation Voltage (pulsed, see note 5)		-0.4		-0.4		-0.4		-0.4	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage (pulsed, see note 5)		-1.6		-1.6		-1.6		-1.6	Volts	I_C = 500 mA	I_B = 50 mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, see note 1)		-1.3		-1.3		-1.3		-1.3	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, see note 1)		-2.6		-2.6		-2.6		-2.6	Volts	I_C = 500 mA	I_B = 50 mA
t_d	Turn-On Delay Time (see Figure 1)		10		10		10		10	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_r	Rise Time (see Figure 1)		40		40		40		40	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_s	Storage Time (see Figure 2)		80		80		80		80	nsec	I_{CS} = 150 mA, I_{B1} =	I_{B2} = 15 mA
t_f	Fall Time (see Figure 2)		30		30		30		30	nsec	I_{CS} = 150 mA, I_{B1} =	I_{B2} = 15 mA
t_{on}	Turn On Time (see Figure 1)				45				45	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_{off}	Turn Off Time (see Figure 2)				100				100	nsec	I_{CS} = 150 mA, I_{B1} =	I_{B2} = 15 mA

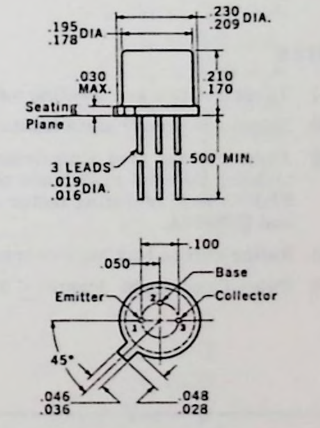
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2904 • 2N2904A
2N2905 • 2N2905A

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N2906 • 2N2906A
2N2907 • 2N2907A

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N2904 2N2906		2N2904A 2N2906A		2N2905 2N2907		2N2905A 2N2907A				
Symbol	Characterisitc	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions	
h_{fe}	High Frequency Current Gain (f = 100 mc)	2.0		2.0		2.0		2.0			I_C = 50 mA	V_{CE} = -20 V
I_{CBO}	Collector Cutoff Current		20		10		20		10	nA	I_E = 0	V_{CB} = -50 V
I_{CBO}(150°C)	Collector Cutoff Current		20		10		20		10	μA	I_E = 0	V_{CB} = -50 V
I_{CEX}	Collector Reverse Current		50		50		50		50	nA	V_{CE} = -30 V	V_{BE} = +0.5 V
I_B	Base Current		50		50		50		50	nA	V_{CE} = -30 V	V_{BE} = +0.5 V
C_{ob}	Output Capacitance (f = 100 kc)		8.0		8.0		8.0		8.0	pf	I_E = 0	V_{CB} = -10 V
C_{TE}	Emitter Transition Capacitance (f = 100 kc)		30		30		30		30	pf	I_C = 0	V_{EB} = -0.5 V
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-60		-60		-60		Volts	I_C = 10 μA	I_B = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-40		-60		-40		-60		Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		-5.0		-5.0		Volts	I_E = 10 μA	I_C = 0

FIG. 1 TEST CIRCUIT FOR DETERMINING DELAY TIME AND RISE TIME

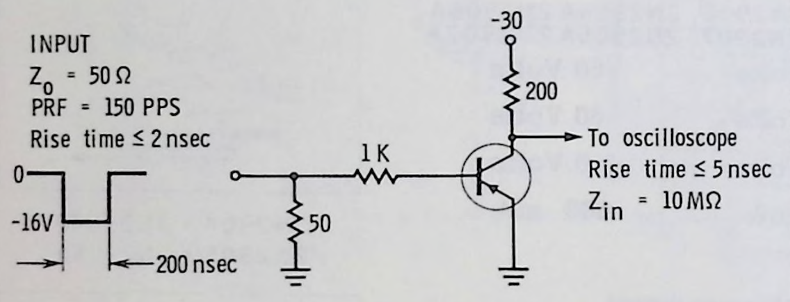
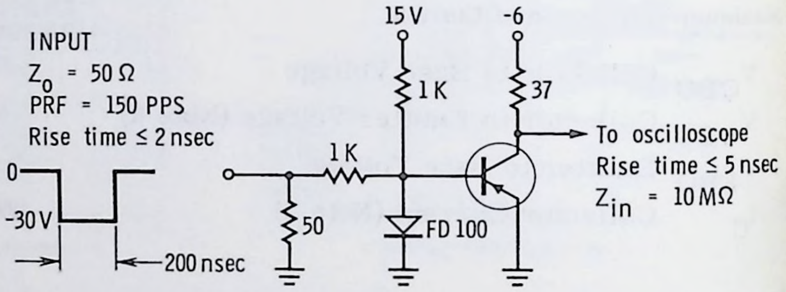


FIG. 2 TEST CIRCUIT FOR DETERMINING STORAGE TIME AND FALL TIME



NOTES

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C); junction-to-ambient thermal resistance of 292°C/Watt (derating factor of 3.42 mW/°C) for the 2N2904, 2N2904A, 2N2905, and 2N2905A. Junction-to-case thermal resistance of 97.3°C/Watt (derating factor of 10.3 mW/°C); junction-to-ambient thermal resistance of 437°C/Watt (derating factor of 2.28 mW/°C) for the 2N2906, 2N2906A, 2N2907, and 2N2907A.

ating refers to a high-current point where collector-to-emitter voltage is lowest.

ılse Conditions: length ≤ 300 μsec; duty cycle ≤ 2%.

Fairchild cannot assume responsibility for use of any circuitry described. No circuit patent licenses are implied.

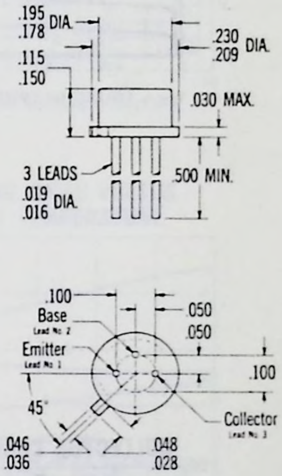
2N3009

FAIRCHILD NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

HIGH SPEED SATURATED SWITCH

e 2N3009 is an NPN silicon PLANAR epitaxial transistor designed for memory applications to 0 milliamperes. It features the unique combination of 350 mc f_T minimum with a guaranteed 0 milliampere collector saturation voltage of 0.5 volt.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-52) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.2 Watts
at 100°C Case Temperature [Notes 2 and 3]	0.68 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.36 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	40 Volts
V_{CES} Collector to Emitter Voltage	40 Volts
V_{CEO} Collector to Emitter Voltage	15 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts

ECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	60	120		I_C = 30 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain [Note 5]	25	55			I_C = 100 mA	V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain [Note 5]	15				I_C = 300 mA	V_{CE} = 1.0 V
V_{CE} (sat)	Collector Saturation Voltage		0.16	0.18	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.18	0.28	Volts	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	Collector Saturation Voltage (+85°C)		0.18	0.3	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat)	Collector Saturation Voltage		0.39	0.5	Volts	I_C = 300 mA	I_B = 30 mA
V_{BE} (sat)	Base Saturation Voltage	0.75	0.82	0.95	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Base Saturation Voltage		0.97	1.2	Volts	I_C = 100 mA	I_B = 10 mA
V_{BE} (sat)	Base Saturation Voltage		1.3	1.7	Volts	I_C = 300 mA	I_B = 30 mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	3.5	5.5			I_C = 30 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		3.3	5.0	pf	I_E = 0	V_{CB} = 5.0 V
C_{Te}	Emitter Transition Capacitance		6.5	8.0	pf	I_C = 0	V_{EB} = 0.5 V
I_{CES}	Collector Reverse Current		0.04	0.5	μA	V_{CE} = 20 V	V_{BE} = 0
I_{CES} (85°C)	Collector Reverse Current		0.5	15	μA	V_{CE} = 20 V	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	I_C = 100 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	I_C = 100 μA	V_{EB} = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	15			Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	I_E = 100 μA	I_C = 0
τ_s	Charge Storage Time Constant [Note 6]		8.0	18	nsec	$I_C = I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA	
t_{on}	Turn On Time [Note 6]		9.0,	15	nsec	$I_C \approx 300$ mA, $I_{B1} \approx 30$ mA	
t_{off}	Turn Off Time [Note 6]		15	25	nsec	$I_C \approx 300$ mA, $I_{B1} \approx 30$ mA, $I_{B2} \approx -30$ mA	

---

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C). Junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).

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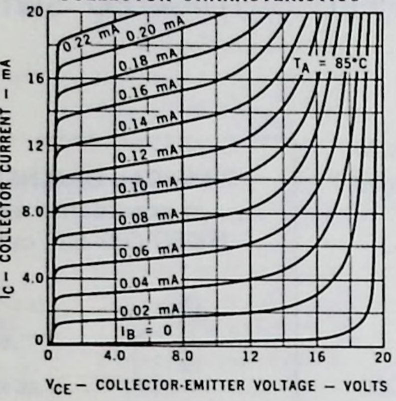
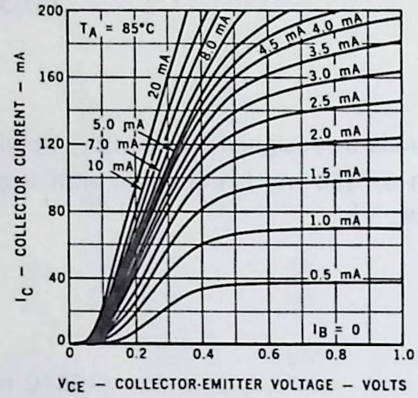
TYPICAL ELECTRICAL CHARACTERISTICS

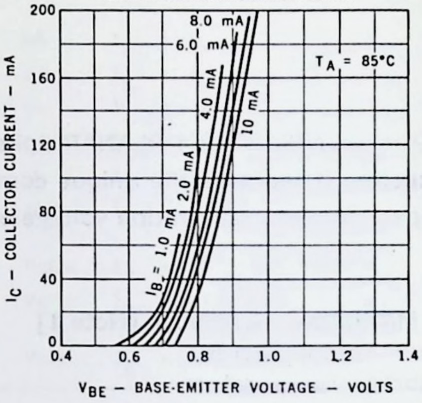
COLLECTOR CHARACTERISTICS*



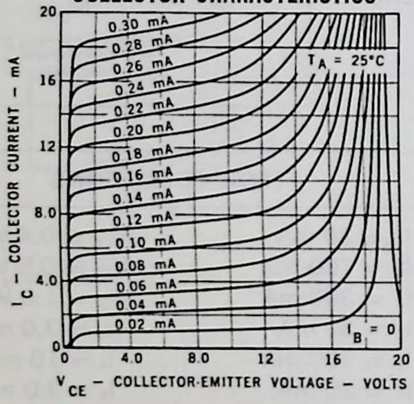
COLLECTOR CHARACTERISTICS*



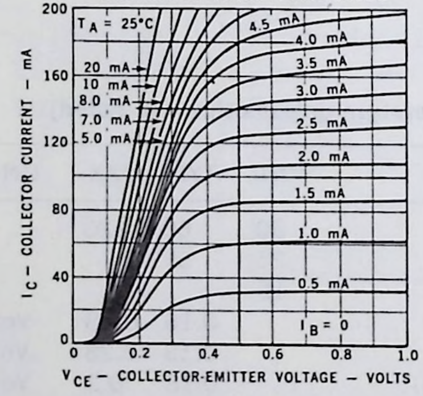
BASE CHARACTERISTICS*



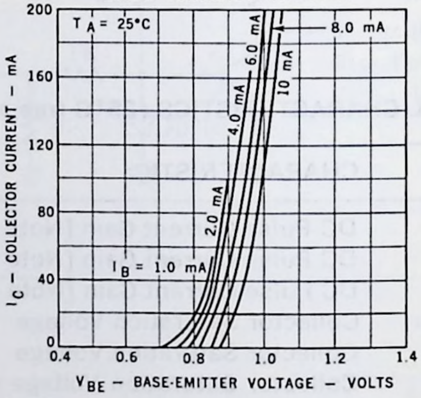
COLLECTOR CHARACTERISTICS*



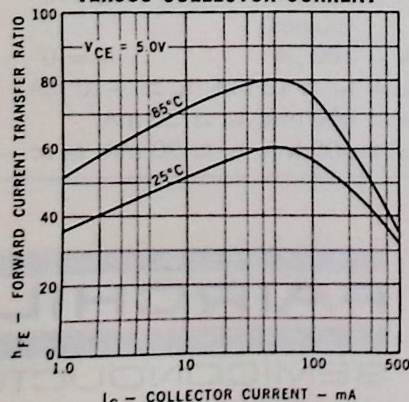
COLLECTOR CHARACTERISTICS*



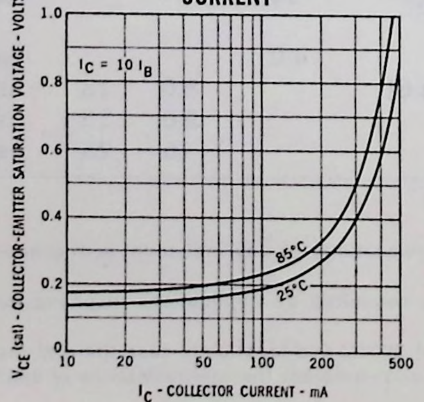
BASE CHARACTERISTICS*



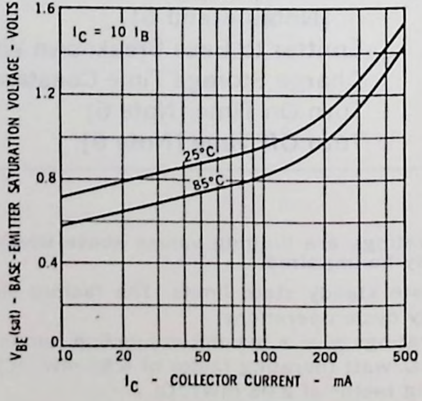
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



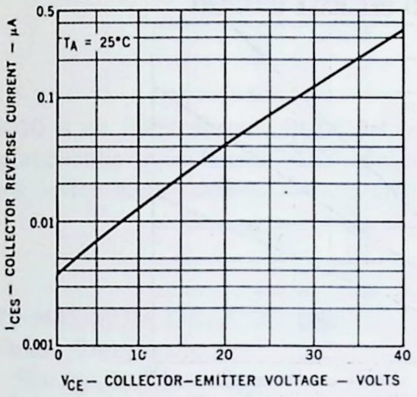
BASE-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



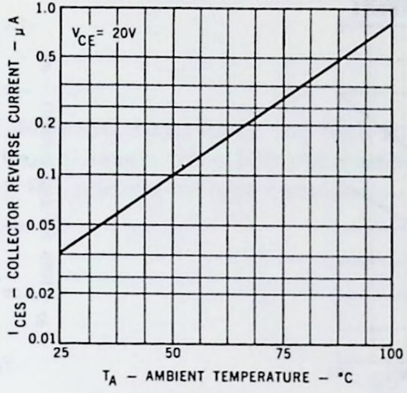
* *Single family characteristics on Transistor Curve Tracer.*

TYPICAL ELECTRICAL CHARACTERISTICS

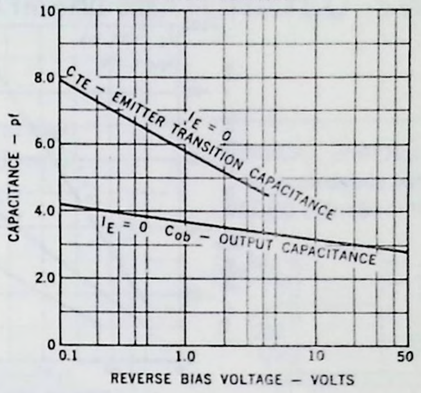
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



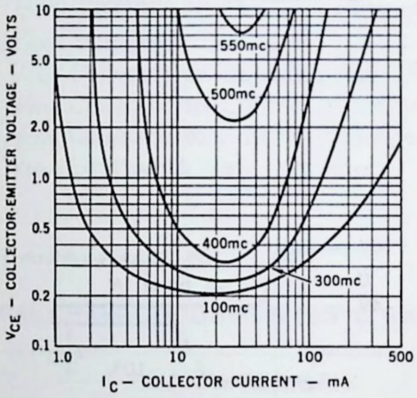
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



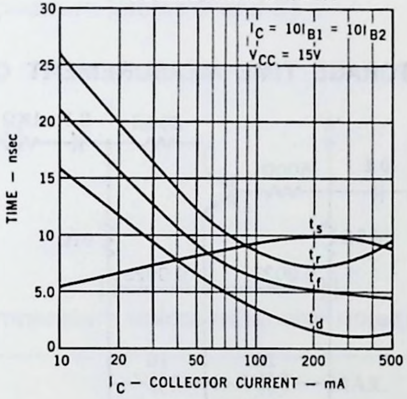
EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



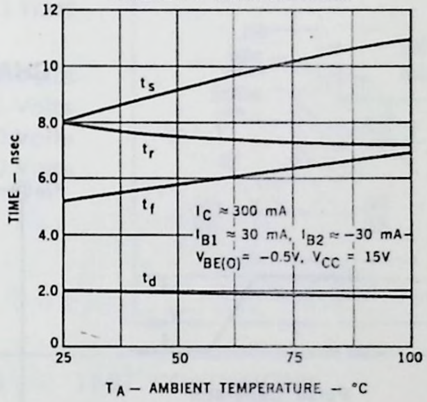
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



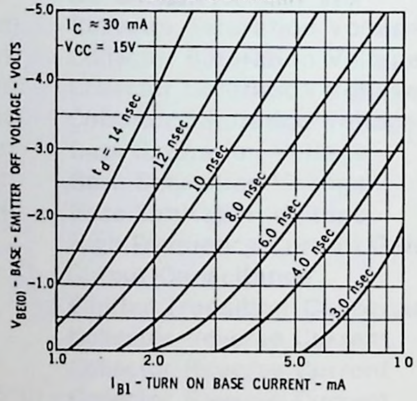
SWITCHING TIMES VERSUS COLLECTOR CURRENT



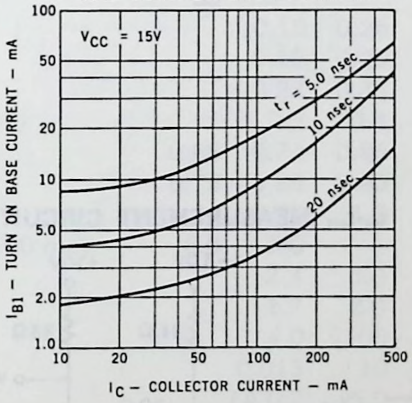
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



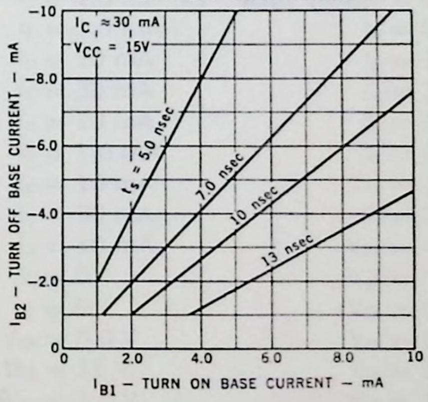
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



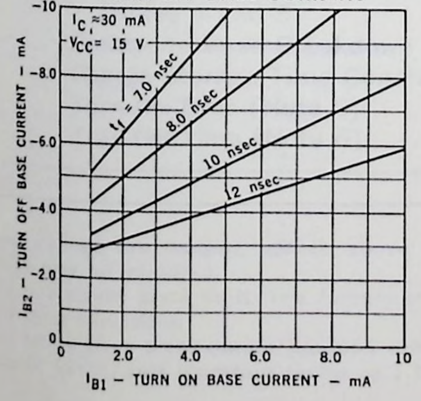
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



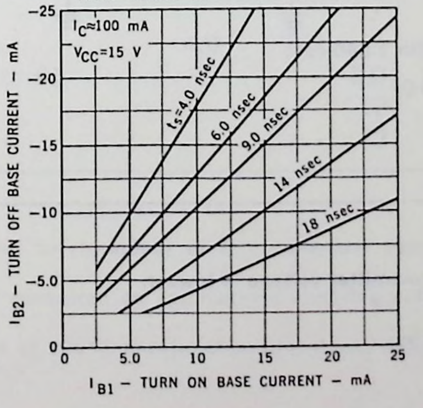
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



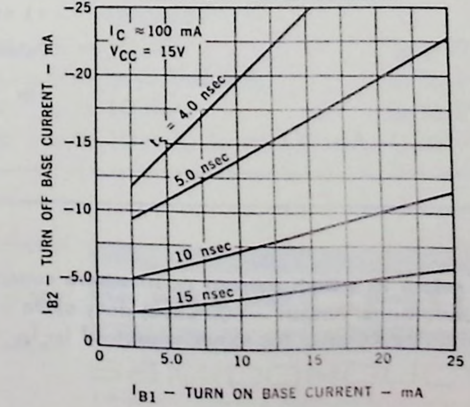
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



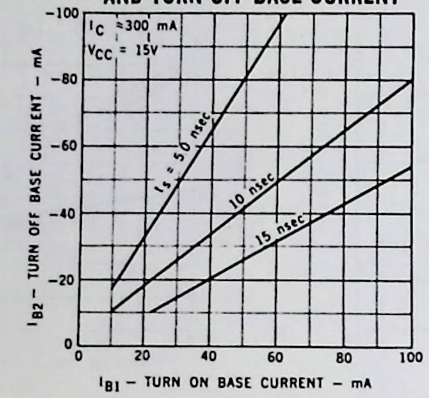
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



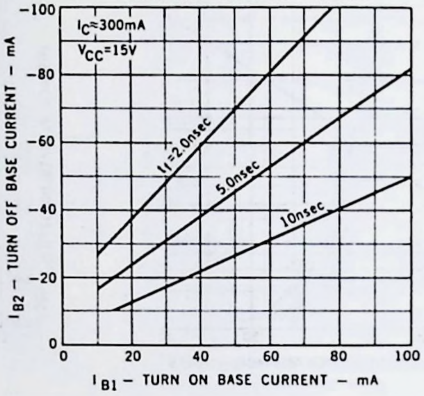
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



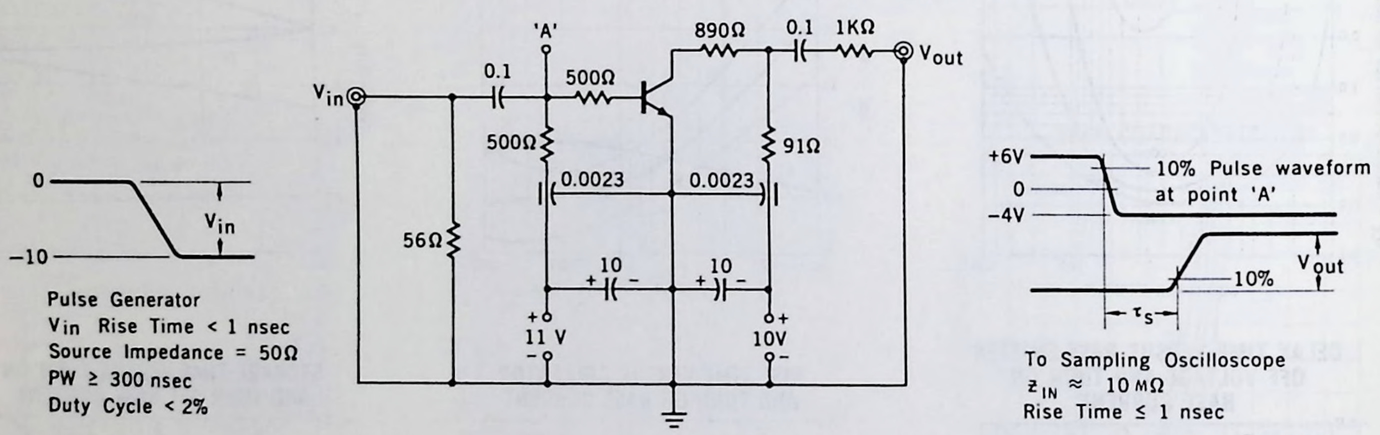
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



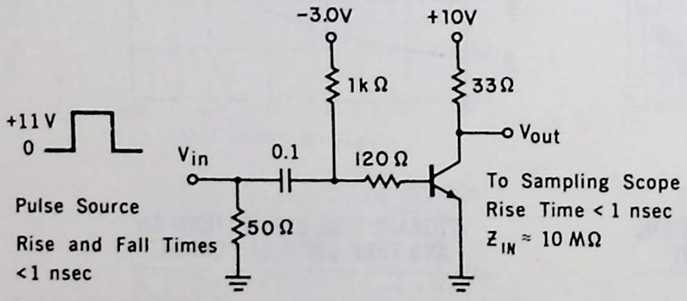
CHARGE STORAGE TIME MEASUREMENT CIRCUIT


0
-10
V_{in}
V_{in}
0.1
'A'
500Ω
500Ω
56Ω
890Ω
0.1
1KΩ
V_{out}
91Ω
0.0023
0.0023
10
10
+
-
+
-
11 V
10V
+6V
0
-4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_s

Pulse Generator
V_{in} Rise Time < 1 nsec
Source Impedance = 50Ω
PW ≥ 300 nsec
Duty Cycle < 2%

To Sampling Oscilloscope
Z_{IN} ≈ 10 MΩ
Rise Time ≤ 1 nsec

t_{on}-t_{off} MEASUREMENT CIRCUIT


-3.0V
+10V
+11 V
0
V_{in}
0.1
1k Ω
120 Ω
50 Ω
33 Ω
V_{out}

Pulse Source
Rise and Fall Times <1 nsec
Pulse Width ≥ 240 nsec
Z_{IN} = 50 Ω

To Sampling Scope
Rise Time < 1 nsec
Z_{IN} ≈ 10 MΩ

---

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

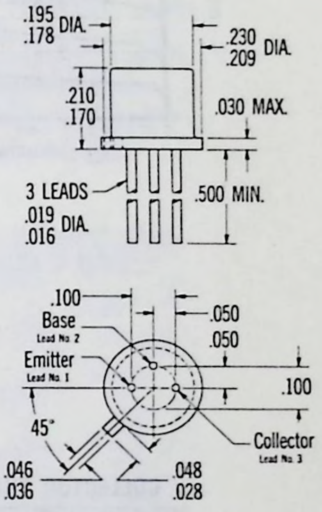
2N3010

FAIRCHILD NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

HIGH SPEED SATURATED SWITCH

The 2N3010 is an NPN silicon PLANAR epitaxial designed specifically for high-speed saturated switching applications in the 50-100 mc range at power levels from 100 microwatts to 300 milliwatts. This device is suitable for most small-signal, RF, and digital type circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Ambient Temperature [Notes 2 and 3]	0.3 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	15 Volts
V_{CES} Collector to Emitter Voltage	11 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	6.0 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	25	70	125		$I_C = 10$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain [Note 5]	15	60			$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Current Gain	15				$I_C = 1.0$ mA	$V_{CE} = 0.4$ V
V_{CE} (sat)	Collector Saturation Voltage		0.18	0.25	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.19	0.25	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.23	0.38	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE} (sat)	Collector Saturation Voltage (+85°C)		0.2	0.4	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Base Saturation Voltage	0.68	0.74	0.85	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{BE} (sat)	Base Saturation Voltage	0.75	0.84	0.95	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Base Saturation Voltage		0.93	1.3	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	6.0	8.0			$I_C = 10$ mA	$V_{CE} = 4.0$ V
C_{ob}	Output Capacitance		2.3	3.0	pf	$I_E = 0$	$V_{CB} = 5.0$ V
C_{TE}	Emitter Transition Capacitance		1.7	2.0	pf	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CES}	Collector Reverse Current		4.0	100	nA	$V_{CE} = 5.0$ V	$V_{EB} = 0$
I_{CES}	Collector Reverse Current		0.013	10	μA	$V_{CE} = 11$ V	$V_{BE} = 0$
I_{CES} (85°C)	Collector Reverse Current		0.2	5.0	μA	$V_{CE} = 5.0$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	15			Volts	$I_C = 10\ \mu$A	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	11			Volts	$I_C = 10\ \mu$A	$V_{EB} = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	6.0			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	$I_E = 10\ \mu$A	$I_C = 0$
τ_s	Charge Storage Time Constant [Note 6]			6.0	nsec	$I_C = I_{B1} \approx 5.0$ mA,	$I_{B2} \approx -5.0$ mA
t_{on}	Turn On Time [Note 6]			12	nsec	$I_C \approx 10$ mA	$I_{B1} \approx 2.0$ mA
t_{off}	Turn Off Time [Note 6]			12	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 1.0$ mA,	$I_{B2} \approx -1.0$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) This is a steady state limit. The factory should be consulted on applications involving pulsed or low duty cycle operations

(3) This rating gives a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 583°C/watt (derating factor of 1.71 mW/°C).

FAIRCHILD
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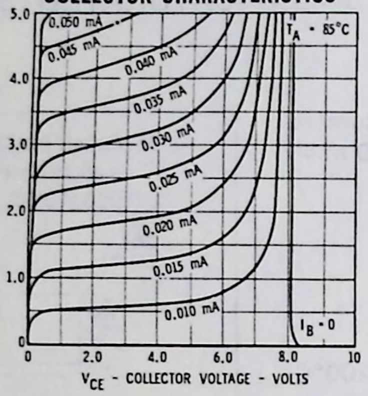
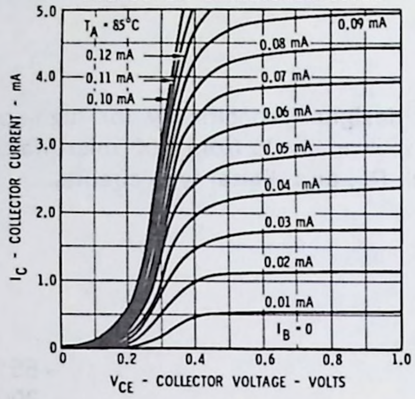
TYPICAL ELECTRICAL CHARACTERISTICS

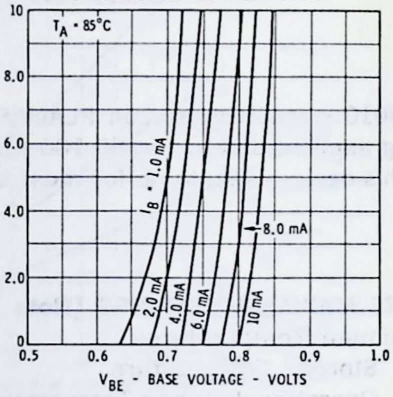
COLLECTOR CHARACTERISTICS*



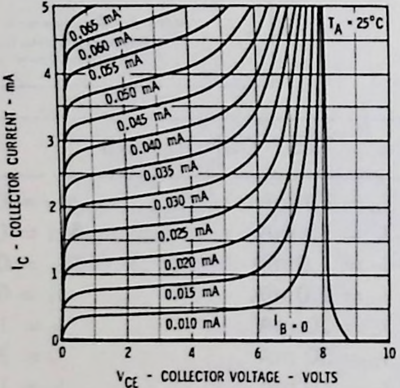
COLLECTOR CHARACTERISTICS*



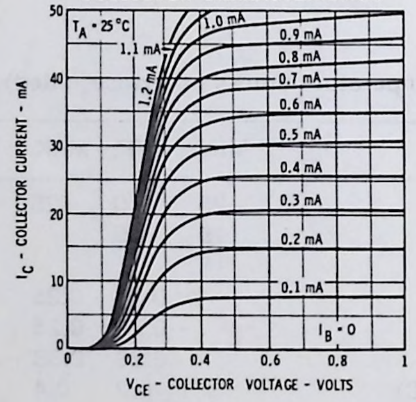
BASE CHARACTERISTICS*



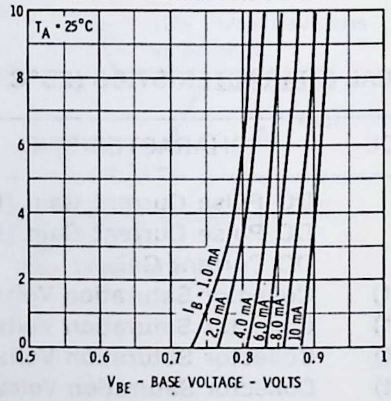
COLLECTOR CHARACTERISTICS*



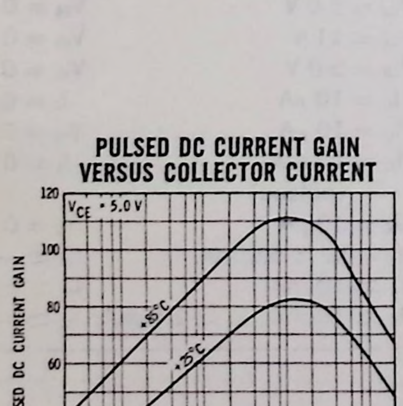
COLLECTOR CHARACTERISTICS*



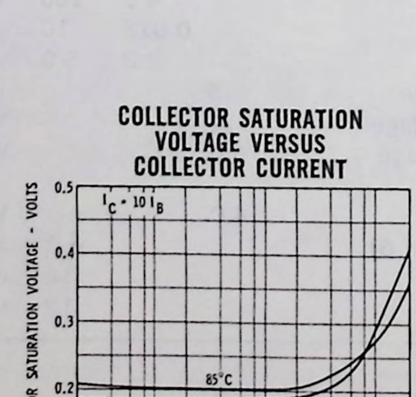
BASE CHARACTERISTICS*



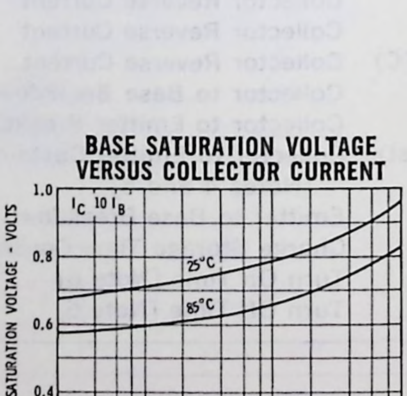
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



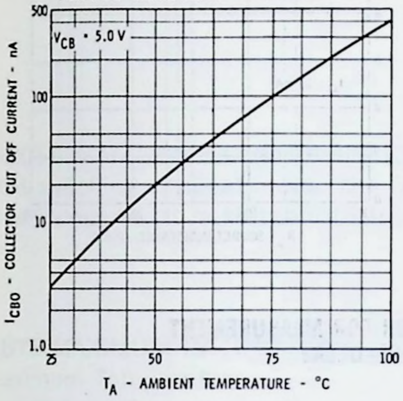
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



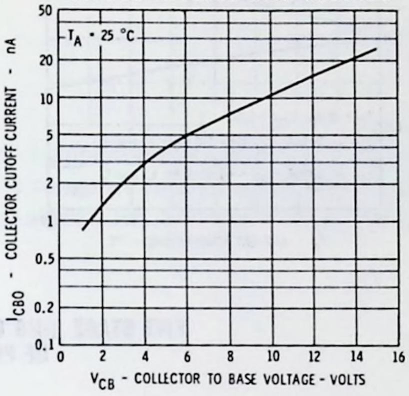
* *Single family characteristics on Transistor Curve Tracer.*

TYPICAL ELECTRICAL CHARACTERISTICS

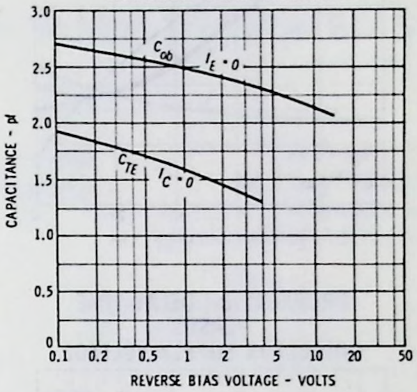
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



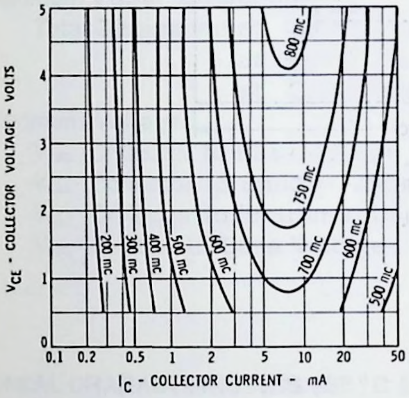
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



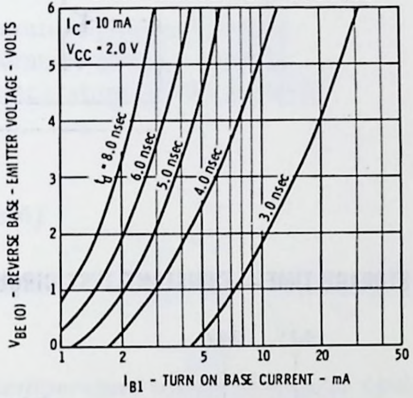
EMITTER TRANSISTION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



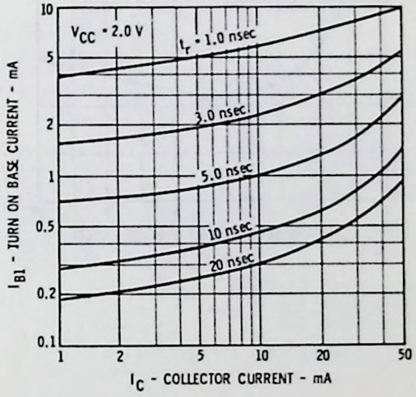
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



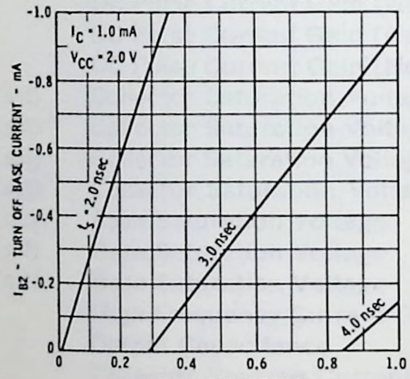
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



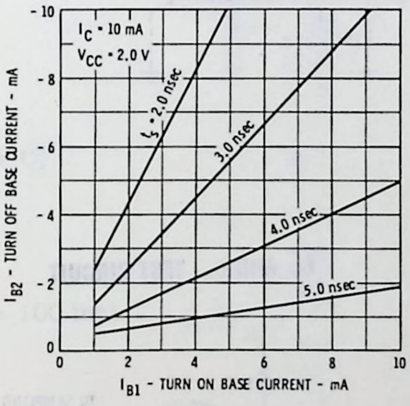
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



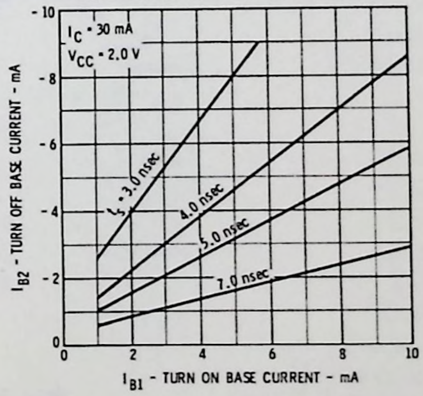
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



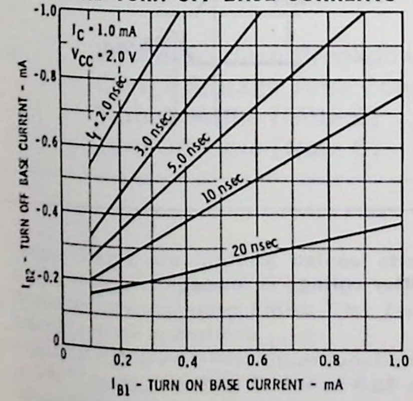
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



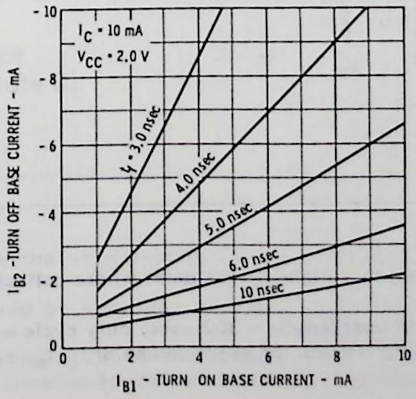
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



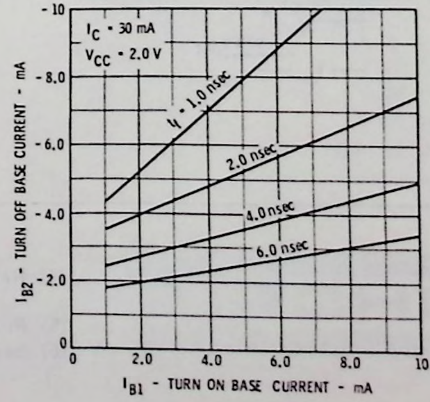
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



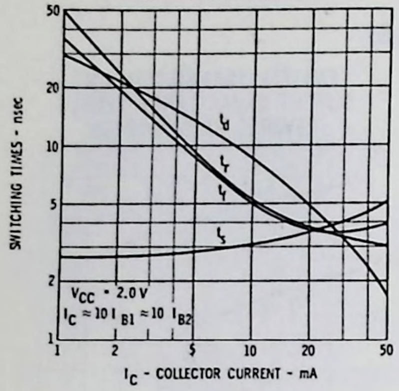
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



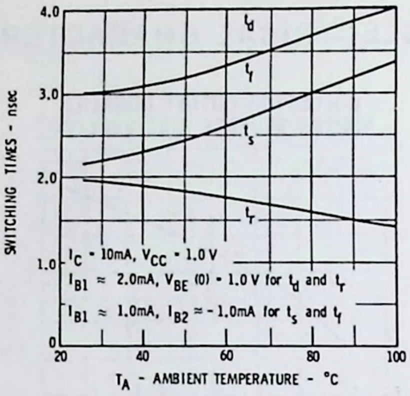
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



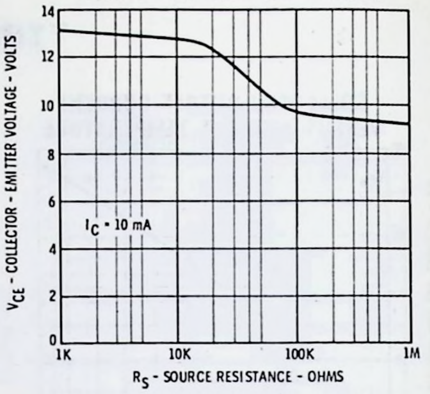
SWITCHING TIMES VERSUS COLLECTOR CURRENT



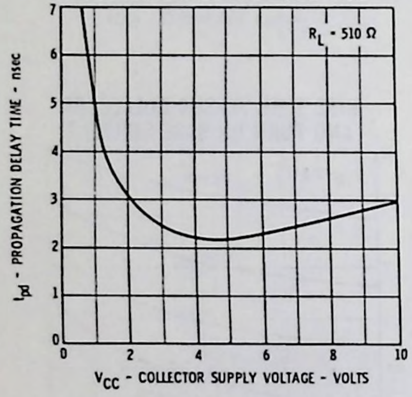
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



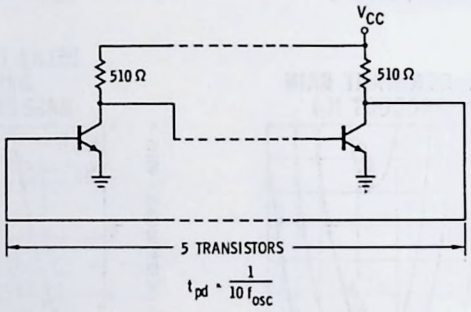
LOWER LIMITING VOLTAGE VERSUS SOURCE RESISTANCE



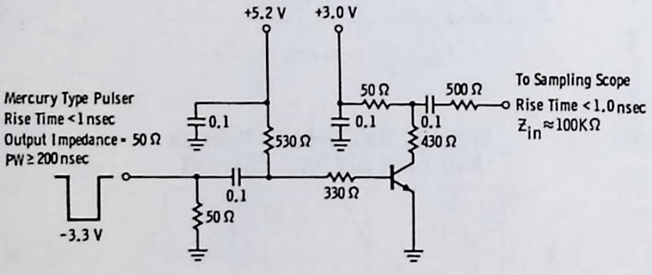
PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



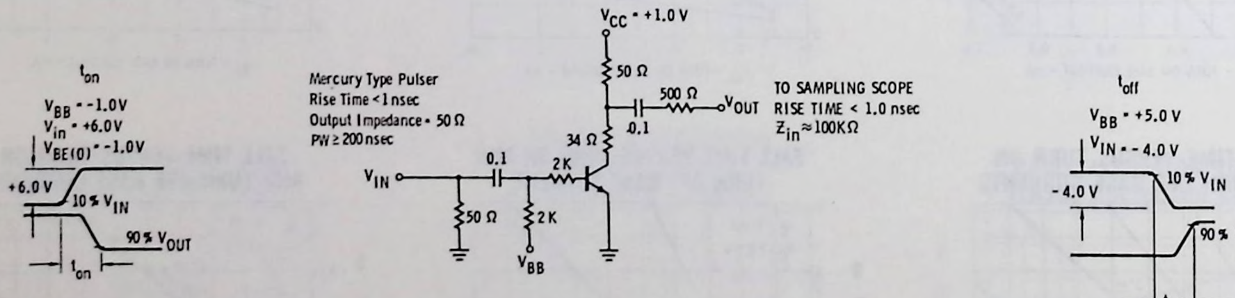
FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY


V_{CC}
510 Ω
510 Ω
5 TRANSISTORS
$t_{pd} = \frac{1}{10\ f_{osc}}$

CHARGE STORAGE TIME — CONSTANT TEST CIRCUIT


+5.2 V
+3.0 V
Mercury Type Pulser
Rise Time <1 nsec
Output Impedance = 50 Ω
PW ≥ 200 nsec
-3.3 V
0.1
530 Ω
0.1
50 Ω
0.1
500 Ω
0.1
430 Ω
0.1
330 Ω
50 Ω
To Sampling Scope
Rise Time <1.0 nsec
$Z_{in} \approx$ 100KΩ

t_{ON} AND t_{OFF} TEST CIRCUIT


t_{on}
V_{BB} = -1.0V
V_{in} = +6.0V
$V_{BE(0)}$ = -1.0V
+6.0 V
10% V_{IN}
90% V_{OUT}
t_{on}
Mercury Type Pulser
Rise Time <1 nsec
Output Impedance = 50 Ω
PW ≥ 200 nsec
V_{CC} = +1.0 V
50 Ω
500 Ω
V_{OUT}
0.1
34 Ω
0.1
2K
V_{IN}
50 Ω
2K
V_{BB}
TO SAMPLING SCOPE
RISE TIME < 1.0 nsec
$Z_{in} \approx$ 100KΩ
t_{off}
V_{BB} = +5.0 V
V_{IN} = -4.0 V
-4.0 V
10% V_{IN}
90% V_{OUT}
t_{off}

---

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

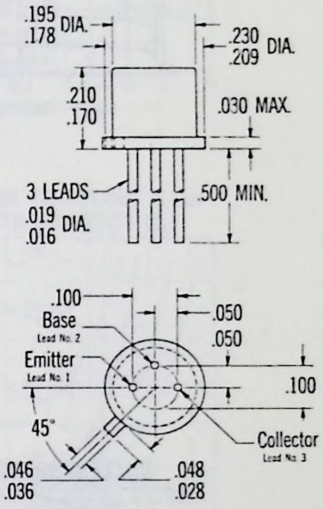
2N3011

FAIRCHILD NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

HIGH SPEED SATURATED SWITCH

The 2N3011 is an NPN silicon PLANAR epitaxial transistor designed specifically for high-speed saturated switching applications in the 50-100 mc range at current levels from 100 microamperes to 100 milliamperes. It is suitable for most small-signal, RF, and digital type circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.2 Watts
at 100°C Case Temperature [Notes 2 and 3]	0.68 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.36 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	12 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	70	120		$I_C = 10$ mA	$V_{CE} = 0.35$ V
h_{FE}	DC Pulse Current Gain [Note 5]	25	75			$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain [Note 5]	12	50			$I_C = 100$ mA	$V_{CE} = 1.0$ V
V_{CE} (sat)	Collector Saturation Voltage		0.17	0.2	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.18	0.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE} (sat)	Collector Saturation Voltage (+85°C)		0.15	0.3	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.3	0.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE} (sat)	Base Saturation Voltage	0.72	0.8	0.87	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Base Saturation Voltage		0.9	1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE} (sat)	Base Saturation Voltage		1.1	1.6	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	4.0	6.5			$I_C = 20$ mA	$V_{CE} = 10$ V
C_{ob}	Output Capacitance		2.3	4.0	pf	$I_E = 0$	$V_{CB} = 5.0$ V
I_{CES}	Collector Reverse Current		0.05	0.4	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CES} (85°C)	Collector Reverse Current		1.0	10	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	30			Volts	$I_C = 10$ μA	$V_{EB} = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage	12			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_E = 100$ μA	$I_C = 0$
τ_s	Charge Storage Time Constant [Note 6]			13	nsec	$I_C = I_{B1} \approx 10$ mA,	$I_{B2} \approx -10$ mA
t_{on}	Turn On Time [Note 6]			15	nsec	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	Turn Off Time [Note 6]			20	nsec	$I_C \approx 30$ mA, $I_{B1} \approx 3.0$ mA,	$I_{B2} \approx -3.0$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

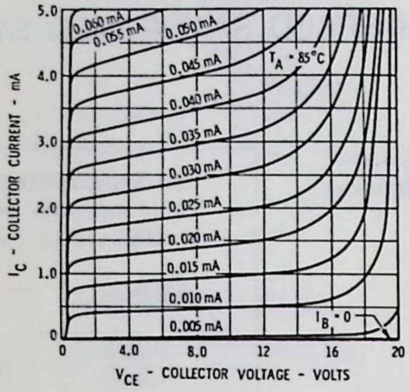
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C). Junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).

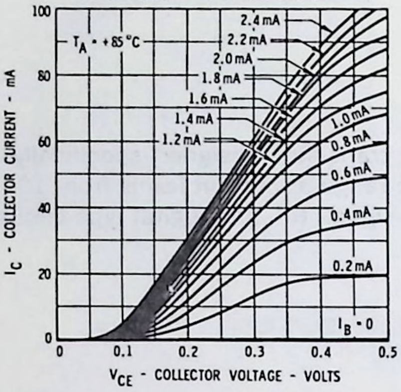
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

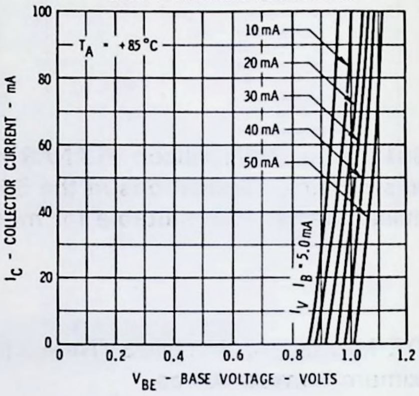
COLLECTOR CHARACTERISTICS*



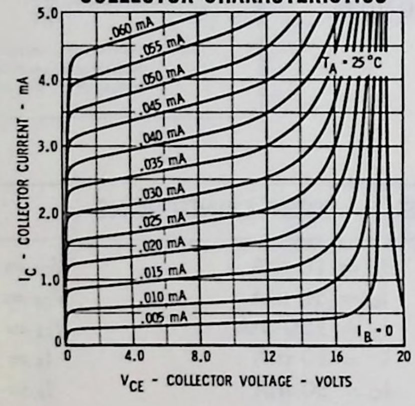
COLLECTOR CHARACTERISTICS*



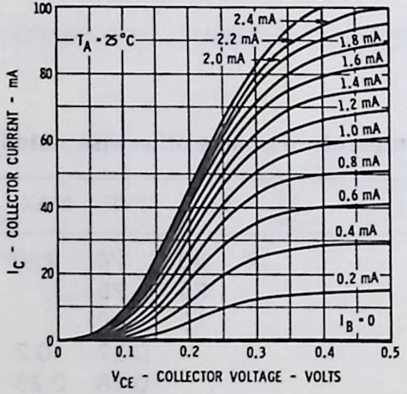
BASE CHARACTERISTICS*



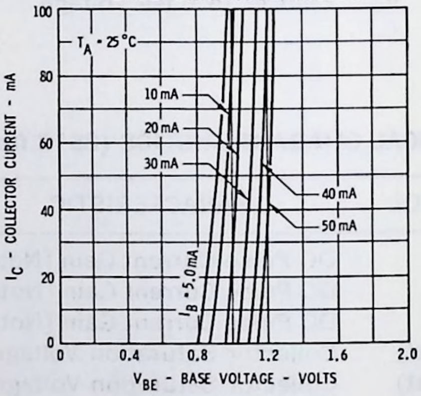
COLLECTOR CHARACTERISTICS*



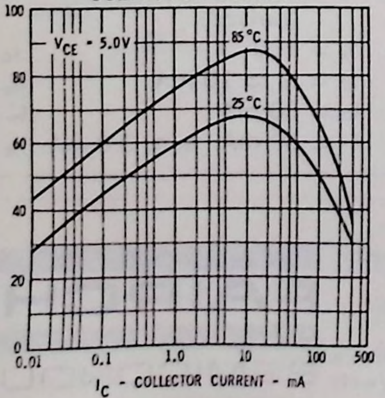
COLLECTOR CHARACTERISTICS*



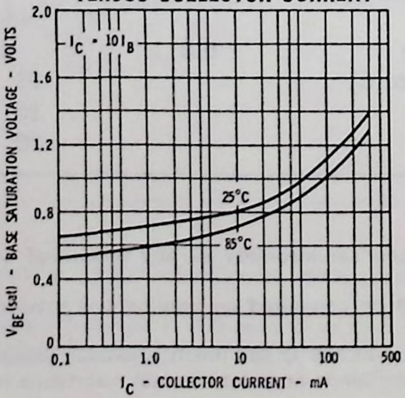
BASE CHARACTERISTICS*



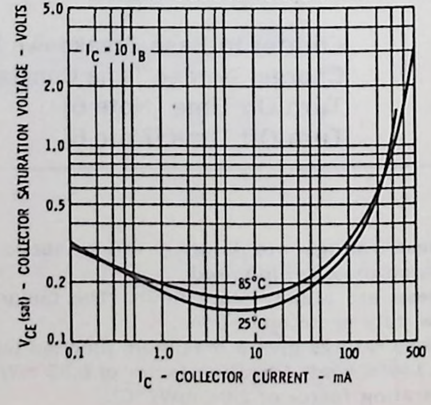
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



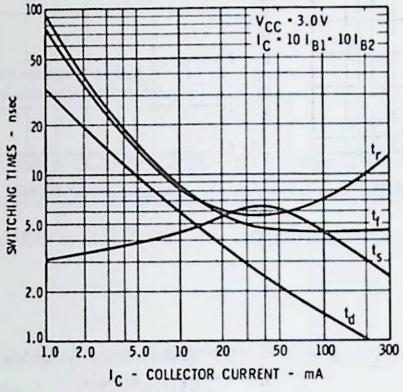
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



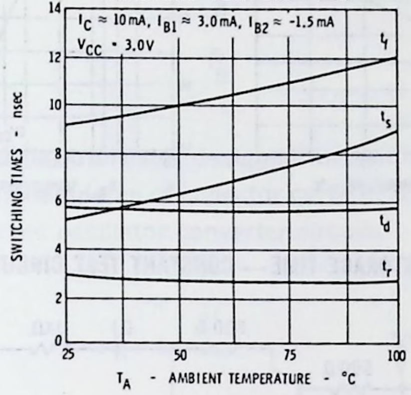
***Single family characteristics on Transistor Curve Tracer.**

TYPICAL ELECTRICAL CHARACTERISTICS

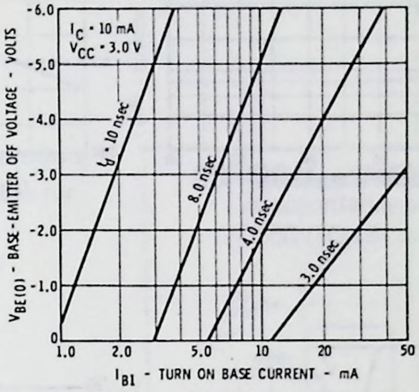
SWITCHING TIMES VERSUS COLLECTOR CURRENT



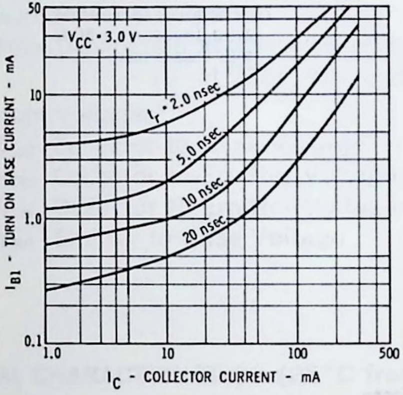
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



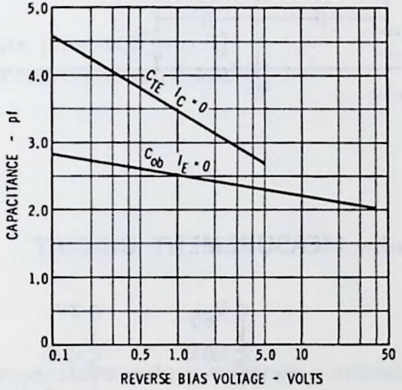
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



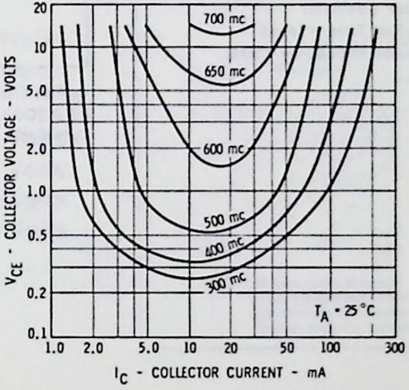
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



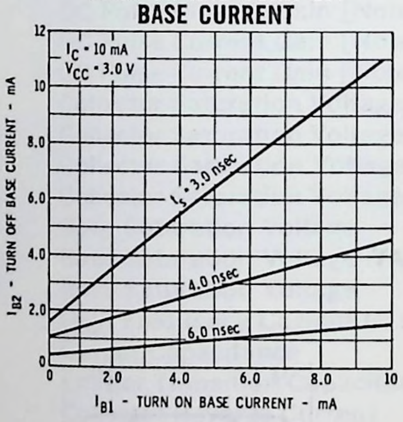
EMITTER TRANSITION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



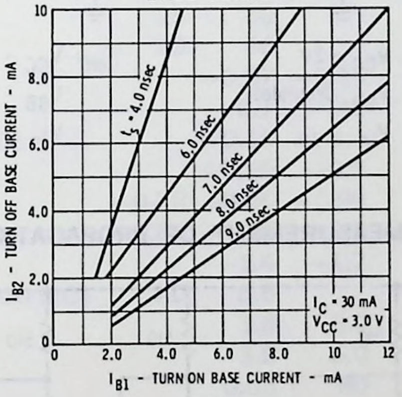
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



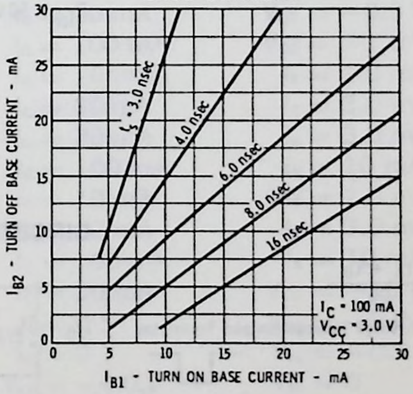
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



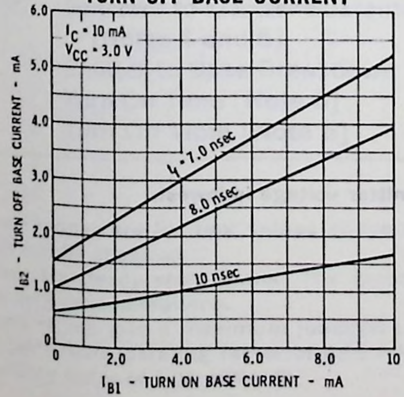
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



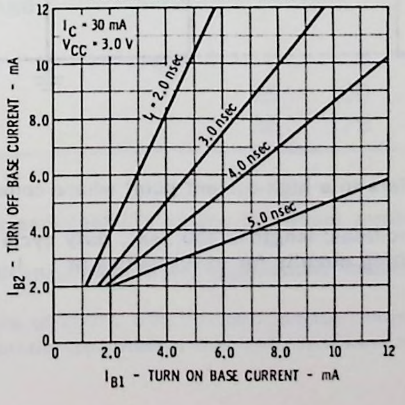
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



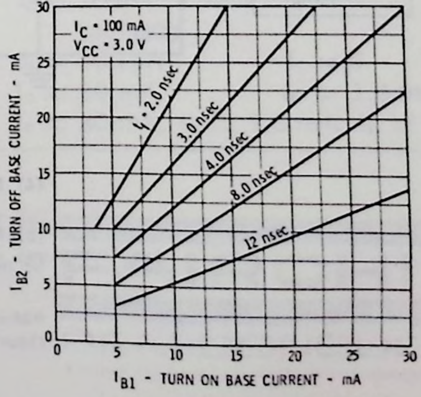
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



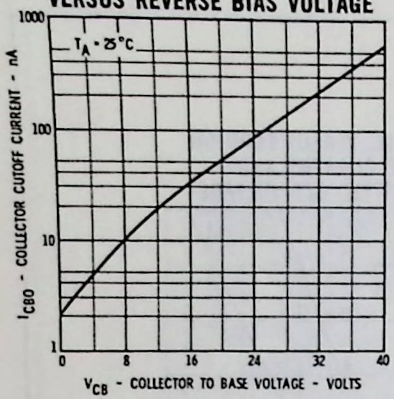
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



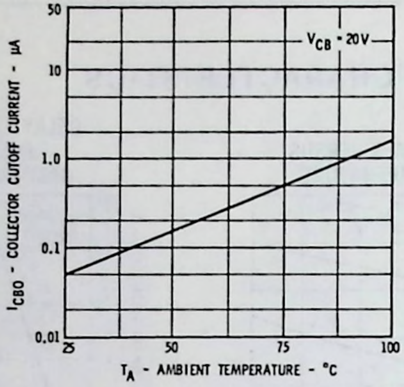
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



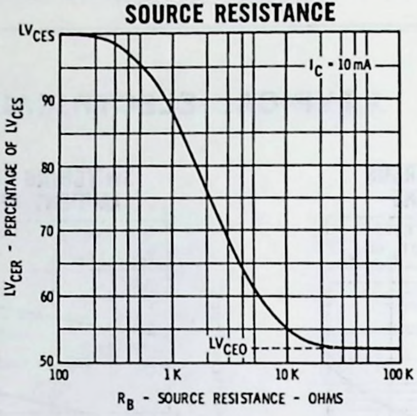
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



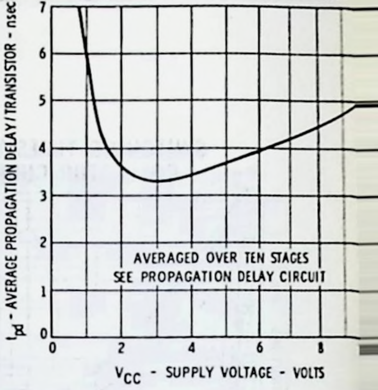
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



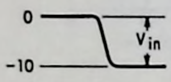
LOWER LIMITING VOLTAGE VERSUS SOURCE RESISTANCE



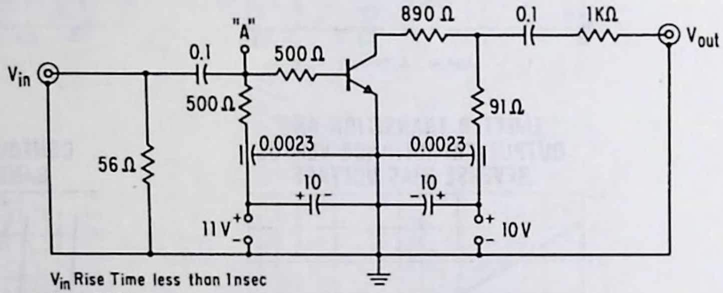
AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE



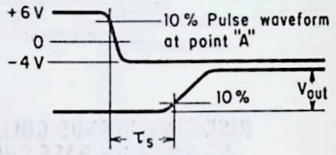
CHARGE STORAGE TIME — CONSTANT TEST CIRCUIT



Pulse Generator
V_{in} Rise Time < 1nsec
Source Impedance = 50Ω

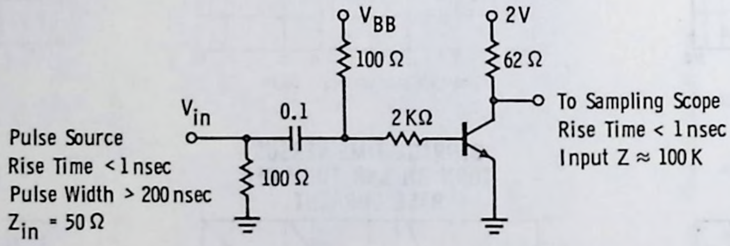

V_in
0.1
"A"
500 Ω
500 Ω
56 Ω
890 Ω
0.1
1KΩ
V_out
91 Ω
0.0023
0.0023
10
10
11 V
10 V

V_{in} Rise Time less than 1nsec
PW ≥ 300 nsec
Duty Cycle < 2%


+6 V
0
-4 V
10% Pulse waveform at point "A"
10%
V_out
τ_s

To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1nsec

t_{on}-t_{off} MEASUREMENT CIRCUIT


V_BB
100 Ω
2V
62 Ω
V_in
0.1
2KΩ
100 Ω
Pulse Source
Rise Time < 1nsec
Pulse Width > 200nsec
Z_in = 50 Ω
To Sampling Scope
Rise Time < 1nsec
Input Z ≈ 100K

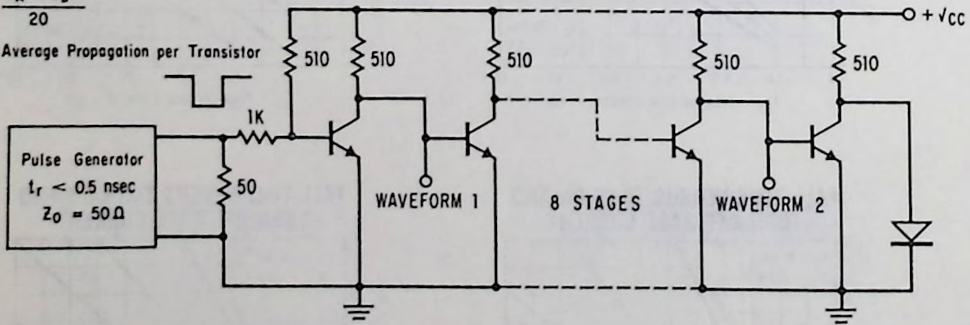
T_{on}: V_{CC} = 2V
V_{BB} Grounded
V_{in} = 7V

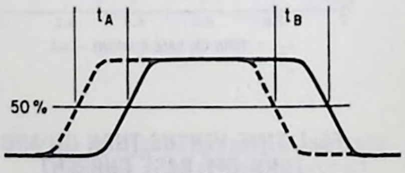
T_{off}: V_{CC} = 2V
V_{BB} = 7V
V_{in} = -13V

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY

$\bar{t}_{pd} = \frac{t_A + t_B}{20}$

$\bar{t}_{pd}$ = Average Propagation per Transistor


+V_CC
510
510
510
510
510
1K
50
Pulse Generator
t_r < 0.5 nsec
Z_0 = 50 Ω
WAVEFORM 1
8 STAGES
WAVEFORM 2



Waveforms 1 and 2 Superimposed

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

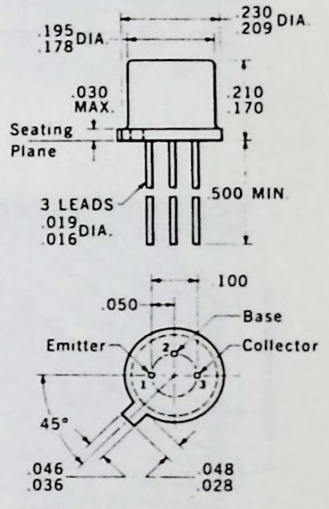
2N3012

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

2N3012 is a 600 mc PNP silicon PLANAR epitaxial transistor designed for saturated and non-turated switching circuits requiring up to 200 milliamperes of collector current. It is suitable for mc amplifiers, 10.7 mc IF amplifiers, and 100 mc oscillator converter circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.2 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.36 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	−12 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	−12 Volts
V_{CES} Collector to Emitter Voltage	−12 Volts
V_{EBO} Emitter to Base Voltage	−4.0 Volts

ECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
	DC Pulse Current Gain [Note 5]	30	70	120		I_C = 30 mA	V_{CE} = −0.5 V
	DC Pulse Current Gain [Note 5]	25	50			I_C = 10 mA	V_{CE} = −0.3 V
	DC Pulse Current Gain [Note 5]	20	40			I_C = 100 mA	V_{CE} = −1.0 V
(sat)	Collector Saturation Voltage		−0.07	−0.15	Volts	I_C = 10 mA	I_B = 1.0 mA
(sat)	Collector Saturation Voltage		−0.1	−0.2	Volts	I_C = 30 mA	I_B = 3.0 mA
(sat)	Collector Saturation Voltage (+85°C)		−0.15	−0.4	Volts	I_C = 30 mA	I_B = 3.0 mA
(sat)	Collector Saturation Voltage		−0.25	−0.5	Volts	I_C = 100 mA	I_B = 10 mA
(sat)	Base Saturation Voltage	−0.78	−0.90	−0.98	Volts	I_C = 10 mA	I_B = 1.0 mA
(sat)	Base Saturation Voltage	−0.85	−1.12	−1.2	Volts	I_C = 30 mA	I_B = 3.0 mA
(sat)	Base Saturation Voltage		−1.4	−1.7	Volts	I_C = 100 mA	I_B = 10 mA
	High Frequency Current Gain (f = 100 mC)	4.0	5.5			I_C = 30 mA	V_{CE} = −10 V
	Output Capacitance		3.3	6.0	pf	I_E = 0	V_{CB} = −5.0 V
	Emitter Transition Capacitance		3.8	6.0	pf	I_C = 0	V_{EB} = −0.5 V
	Collector Reverse Current		0.05	80	nA	V_{CE} = −6.0 V	V_{BE} = 0
(85°C)	Collector Reverse Current		0.003	5.0	μA	V_{CE} = −6.0 V	V_{BE} = 0
	Collector to Base Breakdown Voltage	−12			Volts	I_C = 10 μA	I_E = 0
	Collector to Emitter Breakdown Voltage	−12			Volts	I_C = 10 μA	I_E = 0
(sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	−12			Volts	I_C = 10 mA (pulsed)	I_B = 0
	Emitter to Base Breakdown Voltage	−4.0			Volts	I_E = 100 μA	I_C = 0
	Turn On Time [Note 6]		25	60	nsec	I_C ≈ 30 mA	I_{B1} ≈ 1.5 mA
	Turn Off Time [Note 6]		35	75	nsec	I_C ≈ 30 mA, I_{B1} ≈ 1.5 mA, I_{B2} ≈ −1.5 mA	

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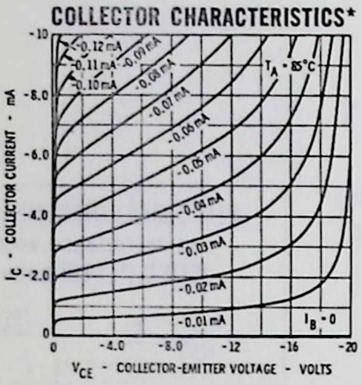
1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C). Junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).

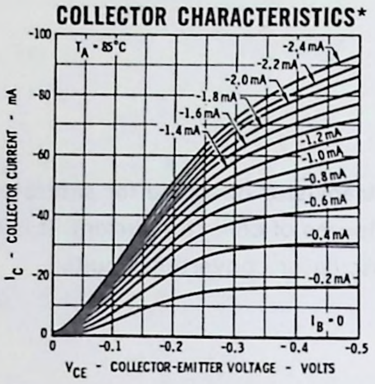
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

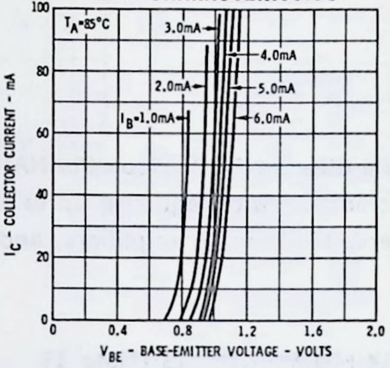
COLLECTOR CHARACTERISTICS*



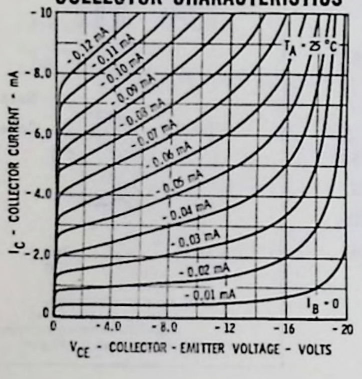
COLLECTOR CHARACTERISTICS*



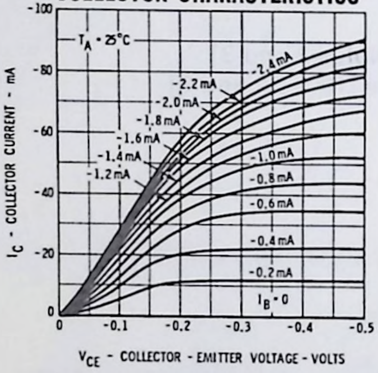
BASE CHARACTERISTICS*



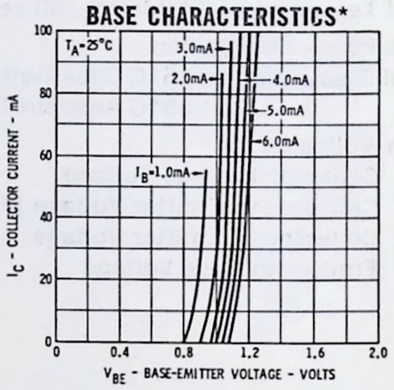
COLLECTOR CHARACTERISTICS*



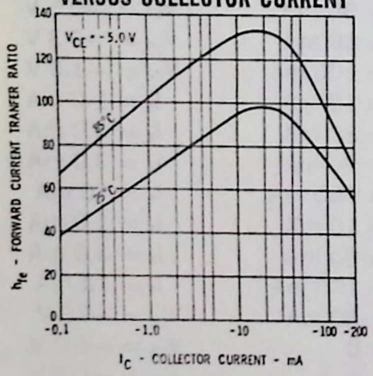
COLLECTOR CHARACTERISTICS*



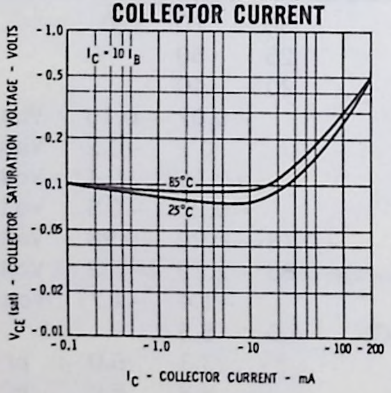
BASE CHARACTERISTICS*



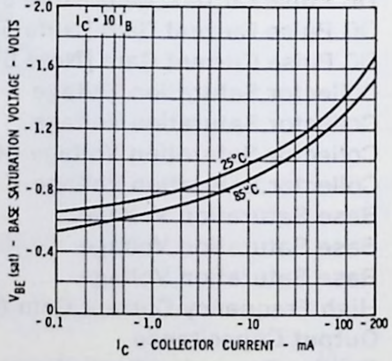
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



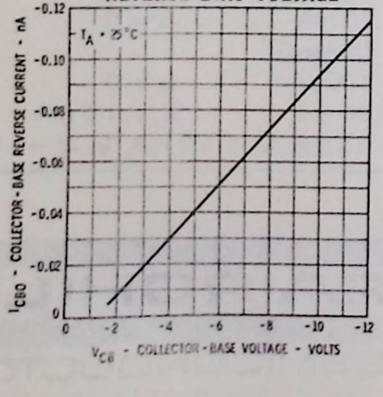
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



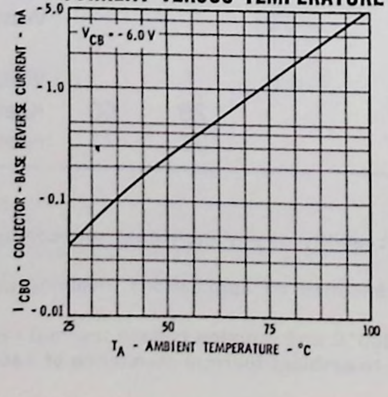
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



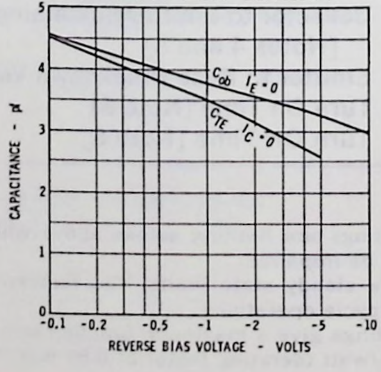
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



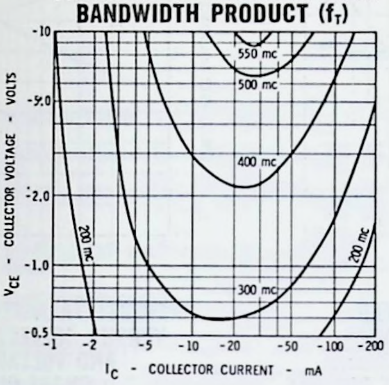
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



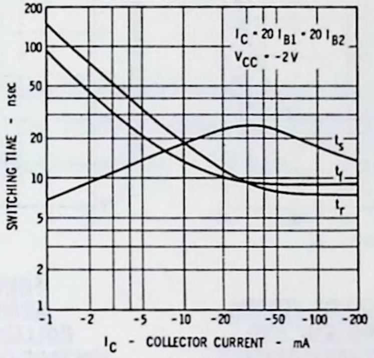
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

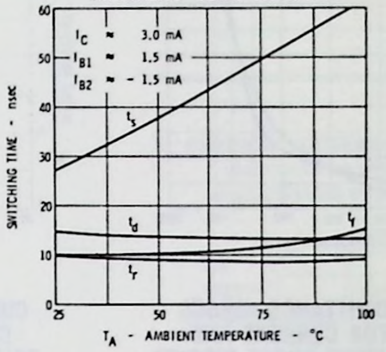
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



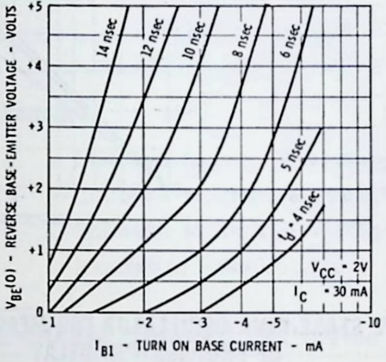
SWITCHING TIMES VERSUS COLLECTOR CURRENT



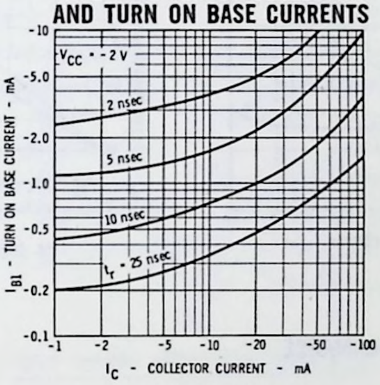
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



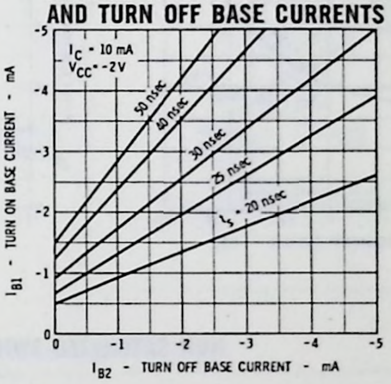
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



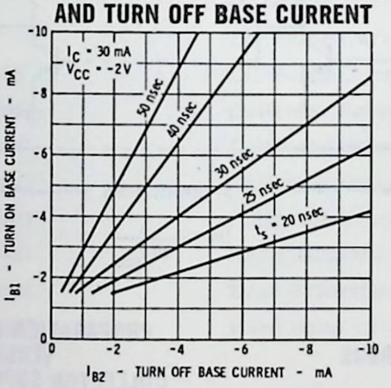
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



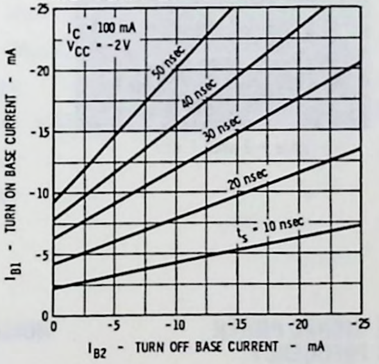
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



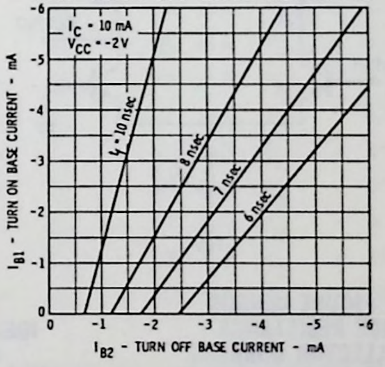
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



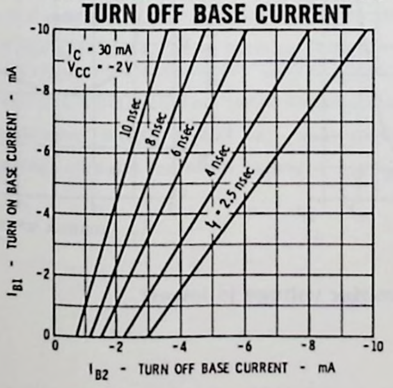
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



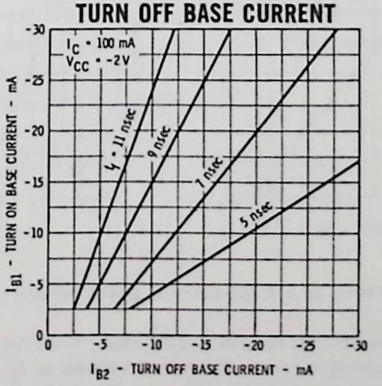
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



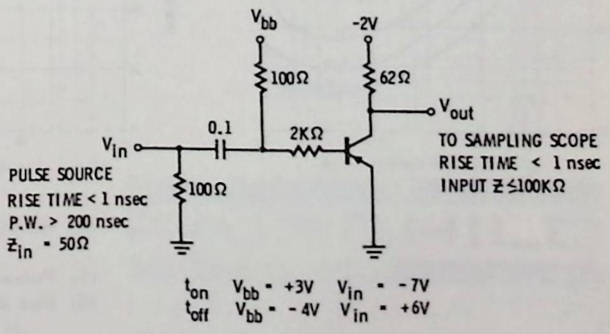
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

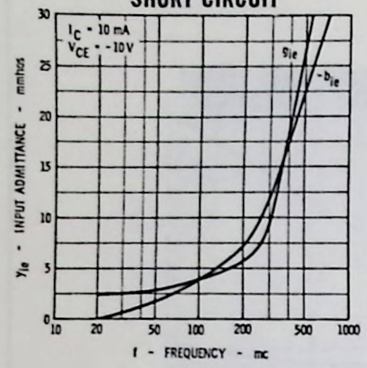


SWITCHING TIME TEST CIRCUIT

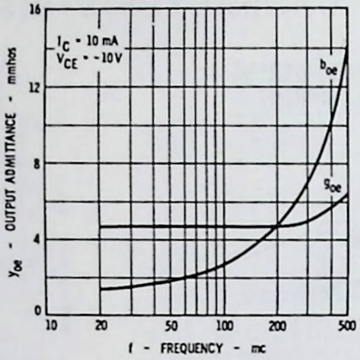

V_{bb}
-2V
100Ω
62Ω
V_{out}
TO SAMPLING SCOPE
RISE TIME < 1 nsec
INPUT Z ≤100KΩ
0.1
2KΩ
V_{in}
PULSE SOURCE
RISE TIME < 1 nsec
P.W. > 200 nsec
Z_{in} = 50Ω
100Ω
t_{on} V_{bb} = +3V V_{in} = -7V
t_{off} V_{bb} = -4V V_{in} = +6V

TYPICAL COMMON EMITTER "Y" PARAMETERS

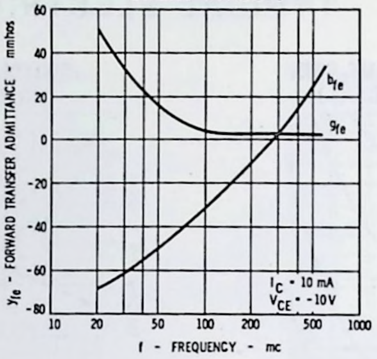
INPUT ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



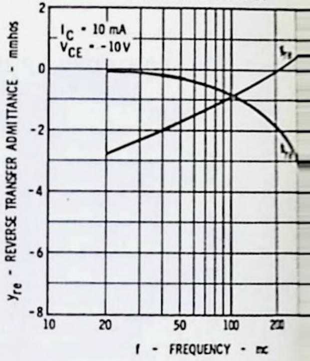
OUTPUT ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



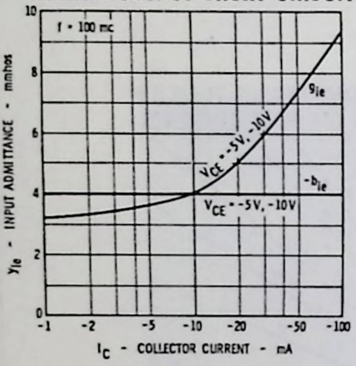
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



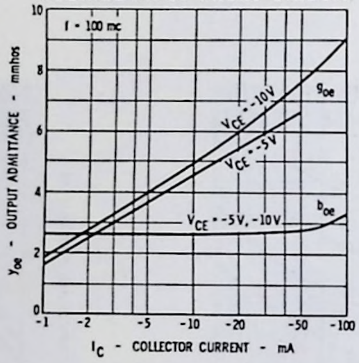
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



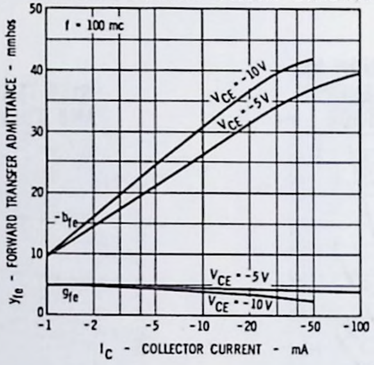
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



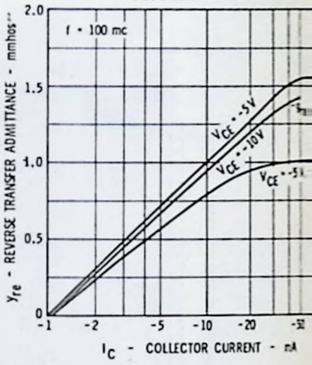
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



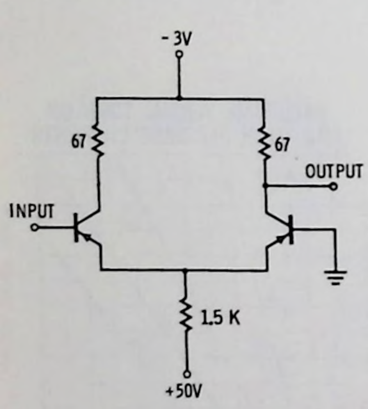
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT

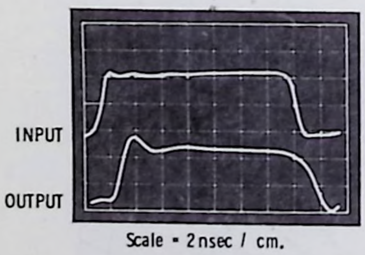


REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



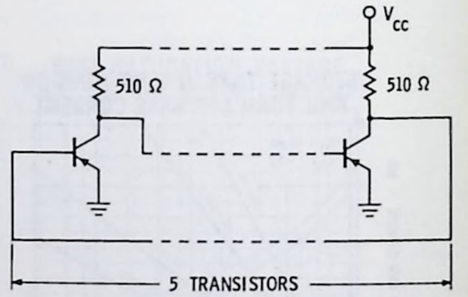
NON SATURATED SWITCHING PERFORMANCE





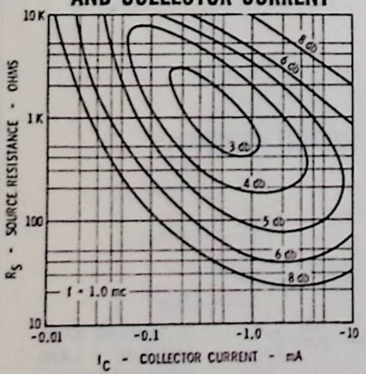
Scale = 2 nsec / cm.

FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

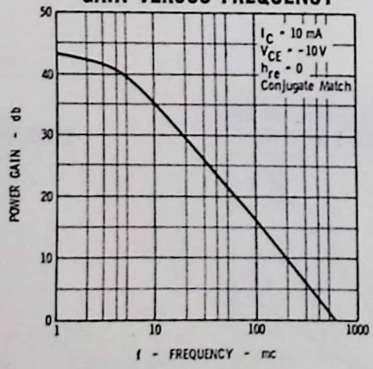


$$tpd = \frac{1}{10\ f_{osc}}$$

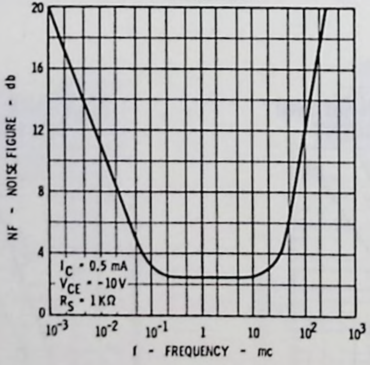
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



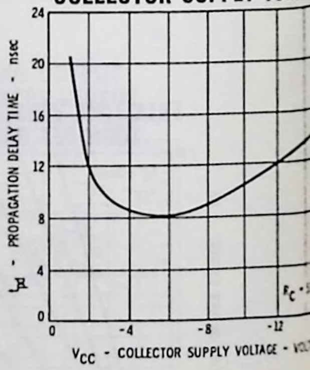
IDEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



NOISE FIGURE VERSUS FREQUENCY



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

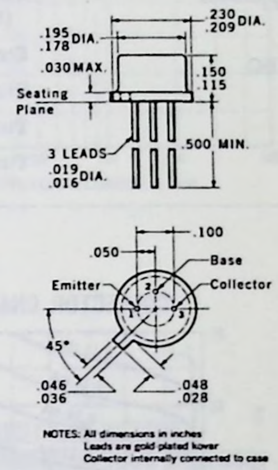
2N3013

NPN HIGH SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The 2N3013 is an NPN Silicon Planar Epitaxial Transistor designed for memory applications to 500 milliamperes. It features the unique combination of 350 MHz minimum f_T with a guaranteed 300 milliampere collector saturation voltage of 0.5 volt.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-52) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Temperature	(Notes 2 and 3)	1.2 Watts
at 100°C Case Temperature	(Notes 2 and 3)	0.68 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.36 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		40 Volts
V_{CES}	Collector to Emitter Voltage		40 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage		5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	30	60	120		I_C = 30 mA V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55			I_C = 100 mA V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	15	40			I_C = 300 mA V_{CE} = 1.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	12	30			I_C = 30 mA V_{CE} = 0.4 V
V_{CE}(sat)	Collector Saturation Voltage		0.16	0.18	Volts	I_C = 30 mA I_B = 3.0 mA
V_{CE}(sat)	Collector Saturation Voltage (+125°C)		0.19	0.25	Volts	I_C = 30 mA I_B = 3.0 mA
V_{CE}(sat)	Collector Saturation Voltage		0.18	0.28	Volts	I_C = 100 mA I_B = 10 mA
V_{CE}(sat)	Collector Saturation Voltage		0.39	0.5	Volts	I_C = 300 mA I_B = 30 mA
V_{BE}(sat)	Base Saturation Voltage	0.75	0.82	0.95	Volts	I_C = 30 mA I_B = 3.0 mA
V_{BE}(sat)	Base Saturation Voltage		0.97	1.2	Volts	I_C = 100 mA I_B = 10 mA
V_{BE}(sat)	Base Saturation Voltage		1.3	1.7	Volts	I_C = 300 mA I_B = 30 mA

Additional Electrical Characteristics on page 2

* Planar is a patented Fairchild process.

NOTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C). Junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).
4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

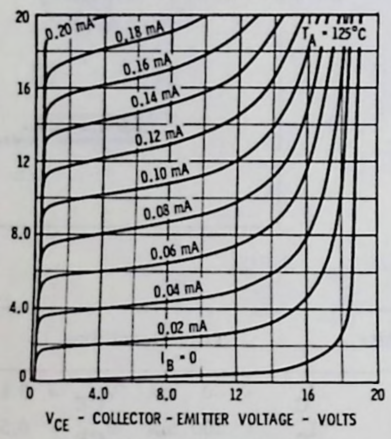
FAIRCHILD TRANSISTOR 2N3013

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

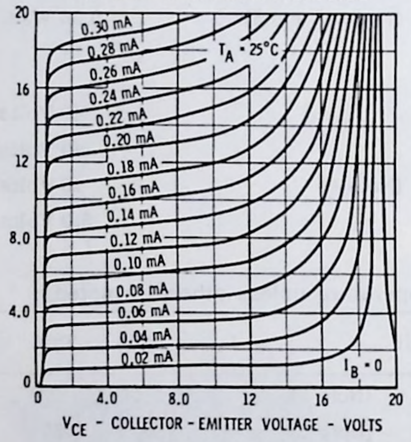
Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.5	5.5			I_C = 30 mA V_{CE} = 10 V
C_{obo}	Output Capacitance		3.3	5.0	pF	I_E = 0 V_{CB} = 5.0 V
C_{ibo}	Emitter Transition Capacitance		6.5	8.0	pF	I_C = 0 V_{EB} = 0.5 V
I_{CES}	Collector Reverse Current		0.04	0.3	μA	V_{CE} = 20 V V_{BE} = 0
I_{CES}(125°C)	Collector Reverse Current		2.0	40	μA	V_{CE} = 20 V V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	I_C = 100 μA I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	I_C = 100 μA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			Volts	$I_{C(pulsed)}$ = 10 mA I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	I_E = 100 μA I_C = 0
τ_s	Charge Storage Time Constant (Note 6)		8.0	18	ns	$I_C = I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA
t_{on}	Turn On Time (Note 6)		9.0	15	ns	$I_C \approx$ 300 mA $I_{B1} \approx$ 30 mA
t_{off}	Turn Off Time (Note 6)		15	25	ns	$I_C \approx 300$ mA, $I_{B1} \approx 30$ mA, $I_{B2} \approx -30$m

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

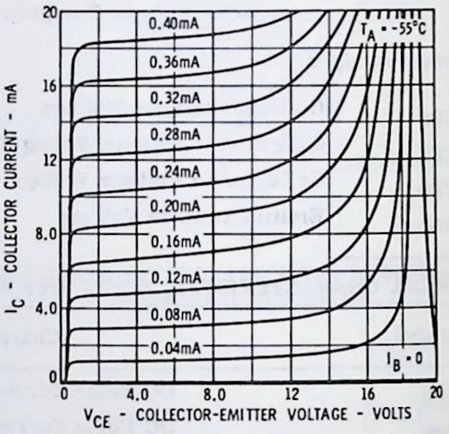
COLLECTOR CHARACTERISTICS



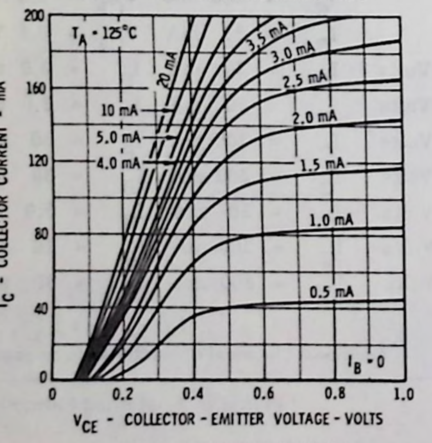
COLLECTOR CHARACTERISTICS



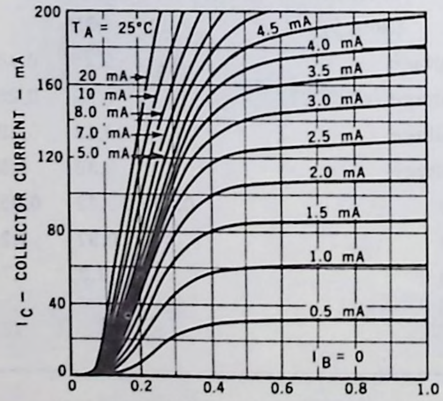
COLLECTOR CHARACTERISTICS



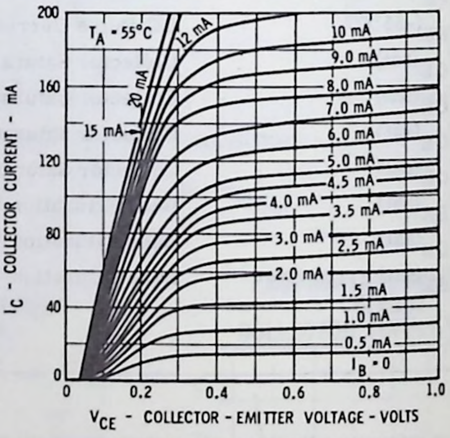
COLLECTOR CHARACTERISTICS



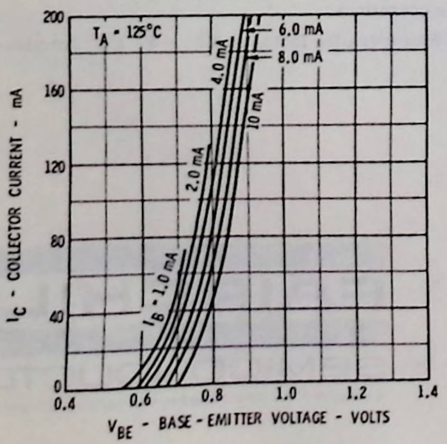
COLLECTOR CHARACTERISTICS



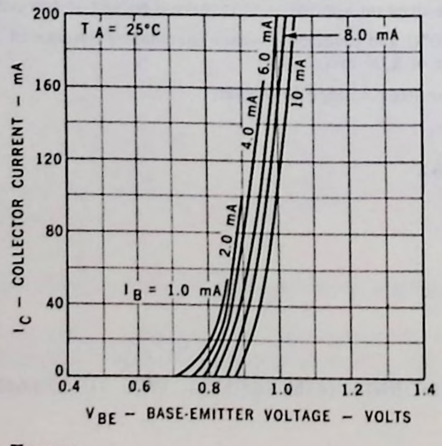
COLLECTOR CHARACTERISTICS



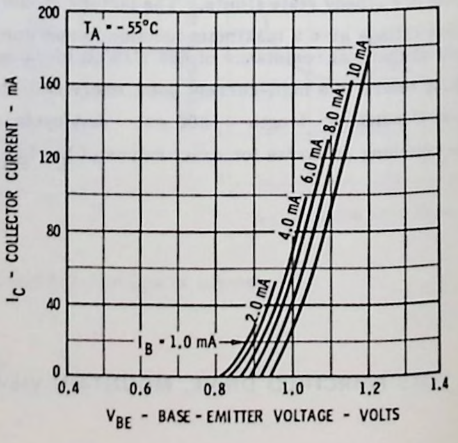
BASE CHARACTERISTICS



BASE CHARACTERISTICS



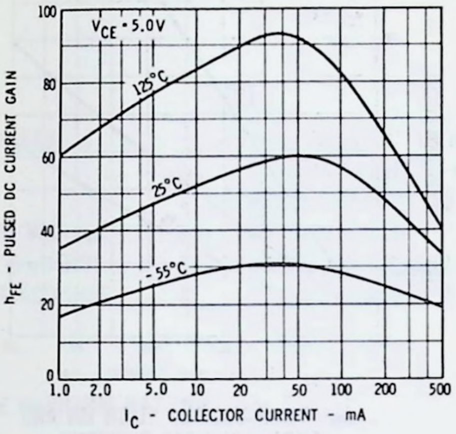
BASE CHARACTERISTICS



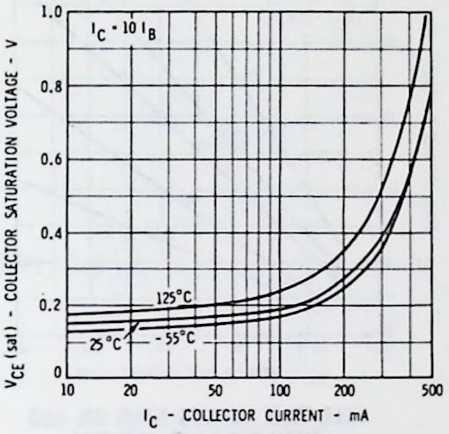
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

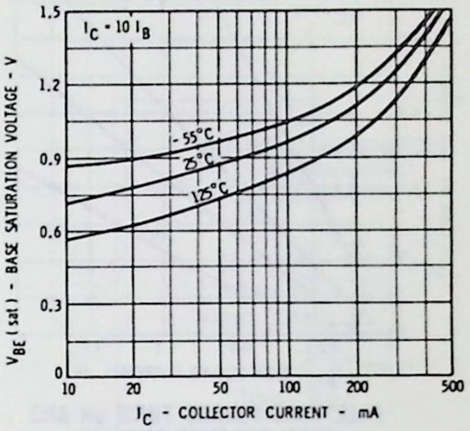
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



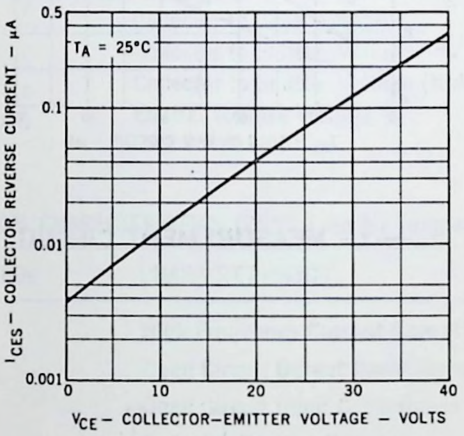
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



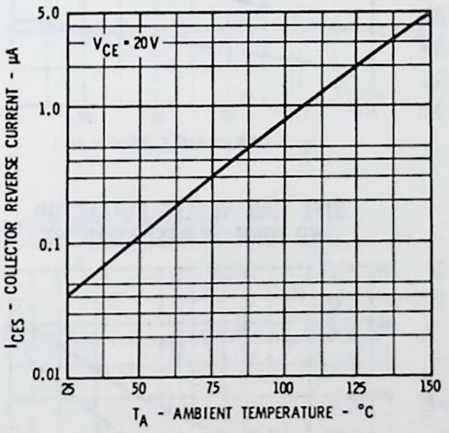
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



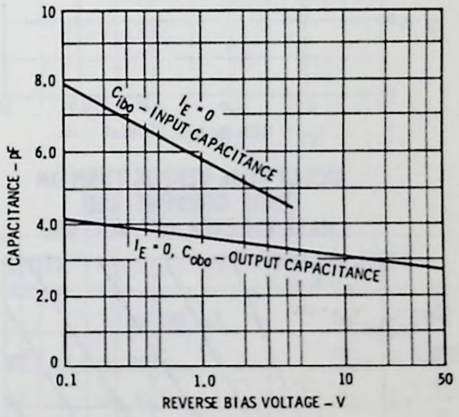
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



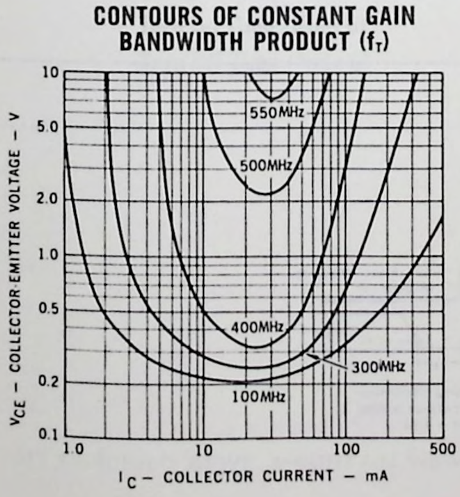
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



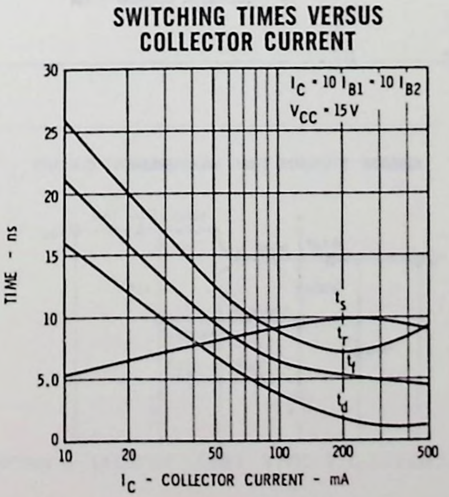
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



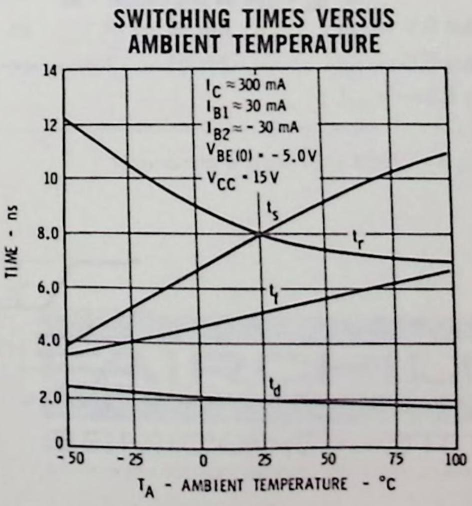
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



SWITCHING TIMES VERSUS COLLECTOR CURRENT

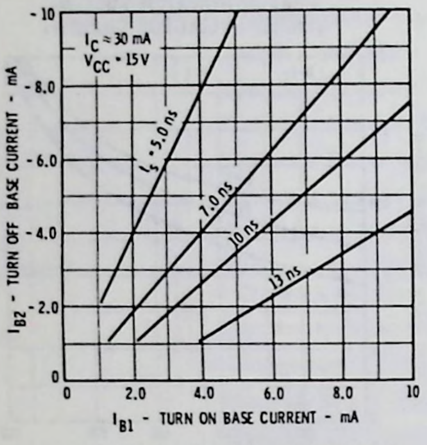


SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

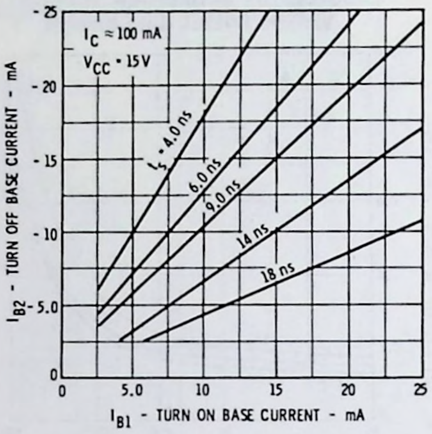


TYPICAL SWITCHING CHARACTERISTICS

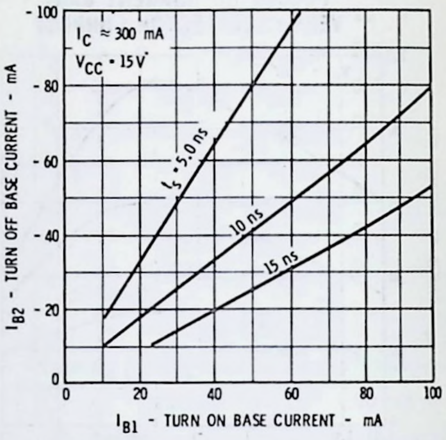
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



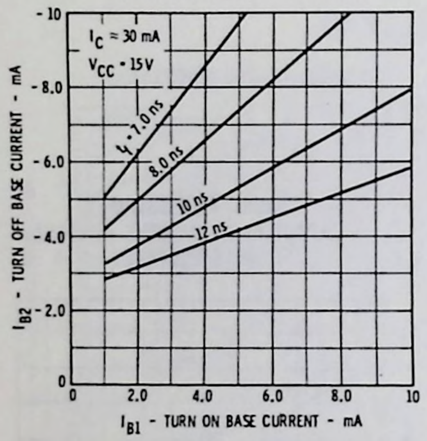
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



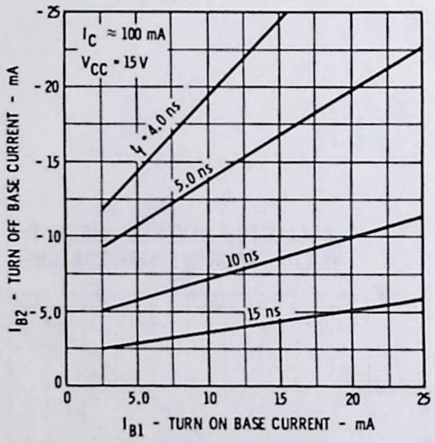
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



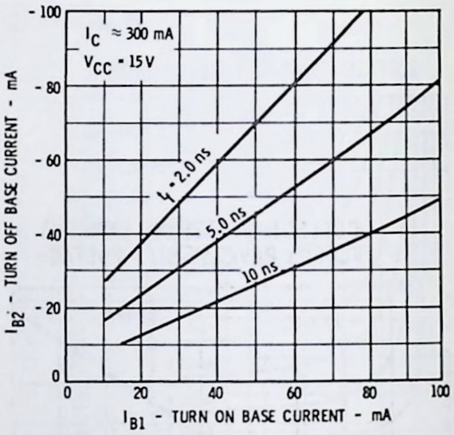
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



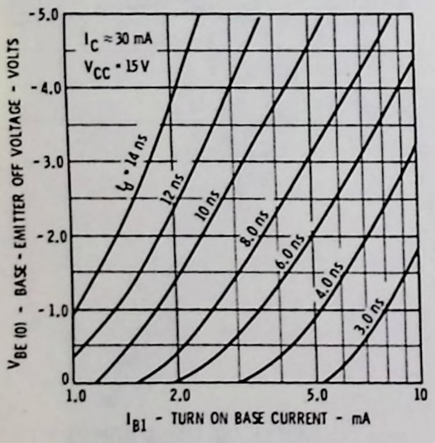
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



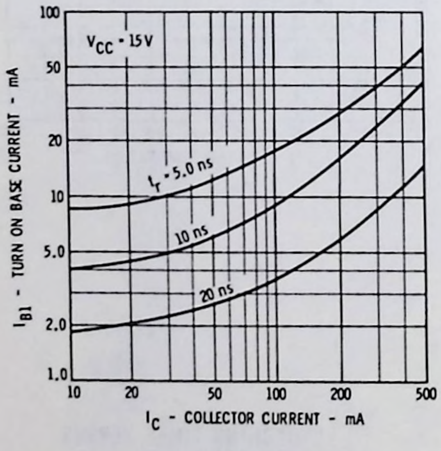
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



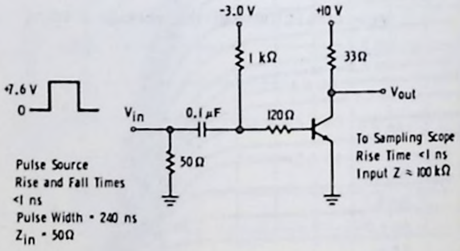
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



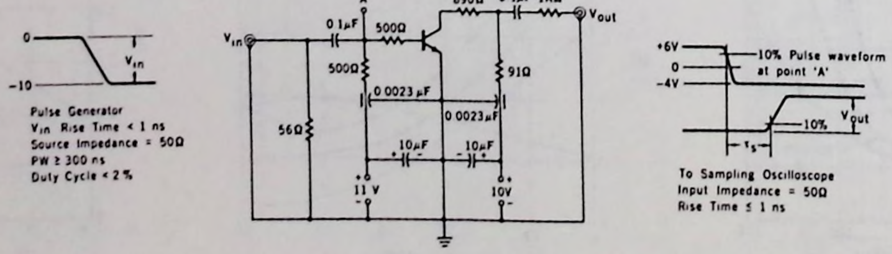
t_{on} — t_{off} MEASUREMENT CIRCUIT


-3.0 V
+10 V
1 kΩ
33Ω
+7.6 V
0
V_{in}
0.1 µF
120Ω
V_{out}
50Ω

Pulse Source
Rise and Fall Times
<1 ns
Pulse Width = 240 ns
Z_{in} = 50Ω

To Sampling Scope
Rise Time <1 ns
Input Z ≈ 100 kΩ

CHARGE STORAGE TIME MEASUREMENT CIRCUIT


0
-10
V_{in}
'A'
890Ω
0.1µF
1kΩ
V_{out}
0.1µF
500Ω
V_{in}
500Ω
91Ω
0.0023 µF
0.0023µF
56Ω
10µF
10µF
+
-
11 V
10V
+6V
0
-4V
10% Pulse waveform at point 'A'
10%
V_{out}
t_s

Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

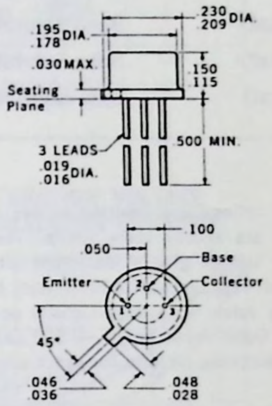
2N3014

NPN HIGH SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

HIGH SPEED . . . . . . $\tau_S = 18$ ns (MAX) AT 10 mA
. . . . . . $t_{on} = 16$ ns (MAX) AT 30 mA
. . . . . . $t_{off} = 25$ ns (MAX) AT 30 mA
MEDIUM VOLTAGE . . . $LV_{CEO} = 20$ V (MIN)
HIGH FREQUENCY . . . $f_T = 350$ MHz (MIN), 550 MHz (TYP) AT 30 mA
LOW CAPACITANCE . . . $C_{obo} = 5.0$ pF (MAX) AT 5.0 V

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-52) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	+300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.2 Watts
at 100°C Case Temperature	0.68 Watt
at 25°C Ambient Temperature	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**3.5**	**5.5**			**$I_C = 30$ mA**	**$V_{CE} = 10$ V**
C_{obo}	**Open Circuit Output Capacitance**		**3.3**	**5.0**	**pF**	**$I_E = 0$**	**$V_{CB} = 5.0$ V**
C_{ibo}	Open Circuit Input Capacitance		6.5	8.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CES}	Collector Reverse Current		0.04	0.3	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CES}(+125°C)	Collector Reverse Current		2.0	40	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	$I_C = 100$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	$I_C = 100$ μA	$V_{BE} = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**20**			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_E = 100$ μA	$I_C = 0$
τ_S	**Charge Storage Time Constant** (Note 6)		**8.0**	**18**	ns	**$I_C = I_{B1} \approx 10$ mA**	**$I_{B2} \approx -10$ mA**
t_{on}	**Turn On Time** (Note 6)		**11**	**16**	ns	**$I_C \approx 30$ mA**	**$I_{B1} \approx 3.0$ mA**
t_{off}	**Turn Off Time** (Note 6)		**16**	**25**	ns	**$I_C \approx 30$ mA**	**$I_{B1} \approx 3.0$ mA** **$I_{B2} \approx -3.0$ mA**

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTOR 2N3014

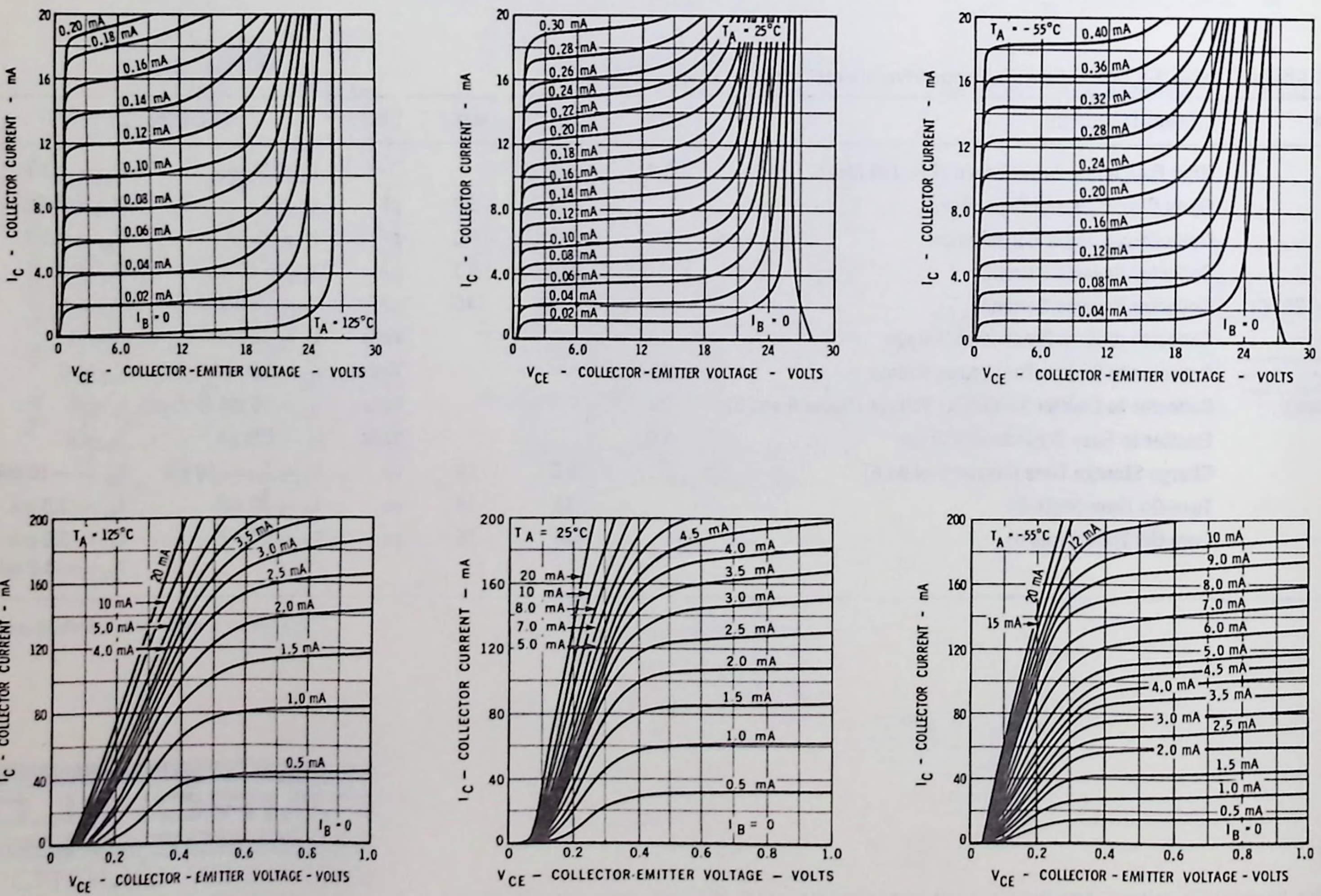
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	30	60	120		$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)	25	45			$I_C = 10$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55			$I_C = 100$ mA	$V_{CE} = 1.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	12	30			$I_C = 30$ mA	$V_{CE} = 0.4$ V
$V_{CE}(sat)$	Collector Saturation Voltage		0.15	0.18	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE}(sat)$	Collector Saturation Voltage		0.16	0.18	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE}(sat)$	Collector Saturation Voltage (+125°C)		0.19	0.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE}(sat)$	Collector Saturation Voltage		0.18	0.35	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE}(sat)$	Base Saturation Voltage	0.7	0.75	0.8	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage	0.75	0.82	0.95	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage		0.97	1.2	Volts	$I_C = 100$ mA	$I_B = 10$ mA

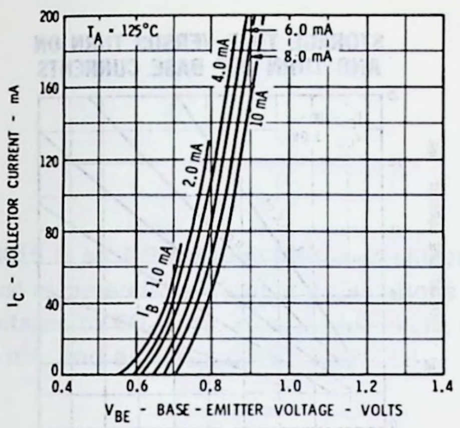
NOTES:

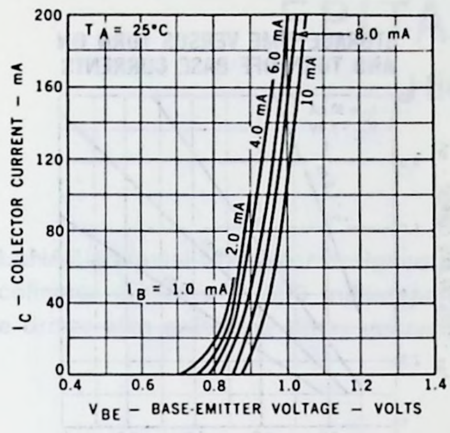
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction to ambie thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).
(4) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

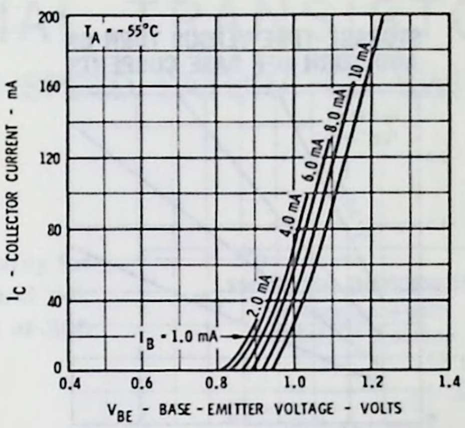
TYPICAL COLLECTOR CHARACTERISTICS



TYPICAL BASE CHARACTERISTICS

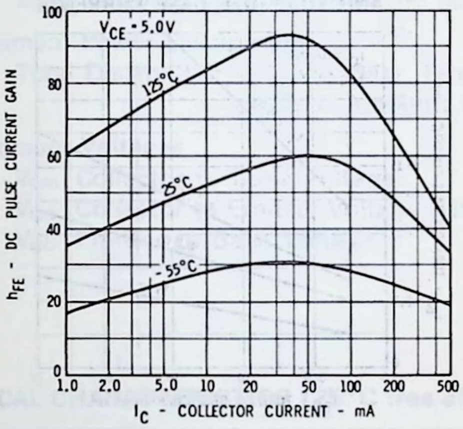




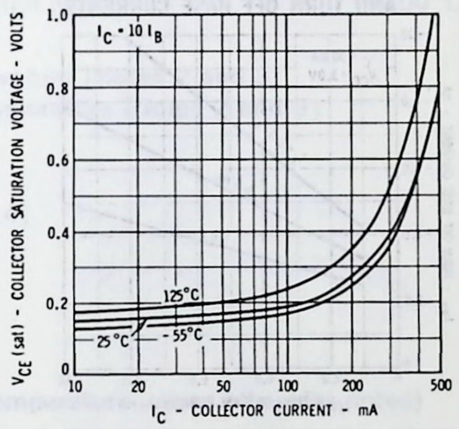


TYPICAL ELECTRICAL CHARACTERISTICS

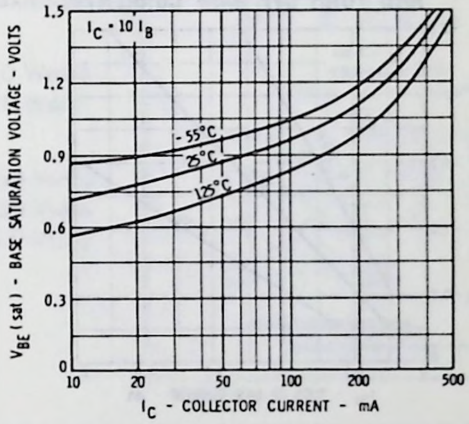
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



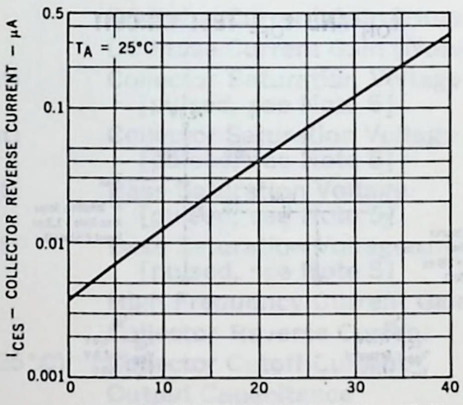
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



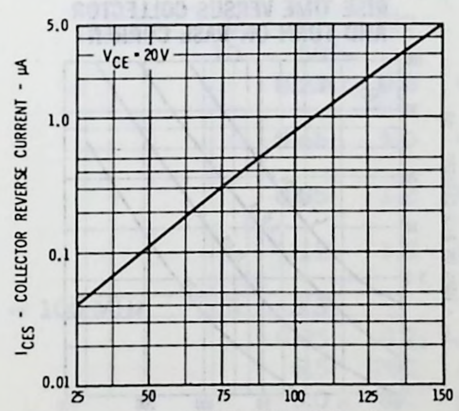
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



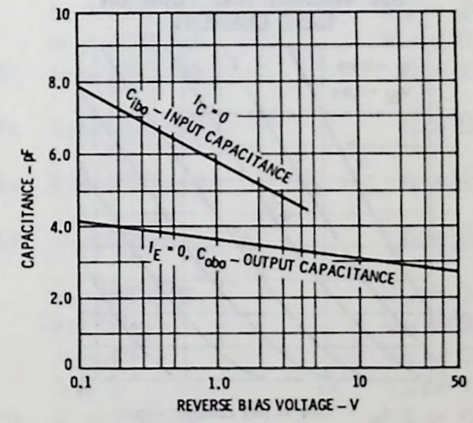
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



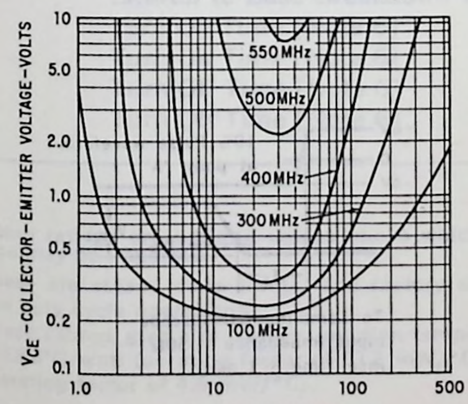
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



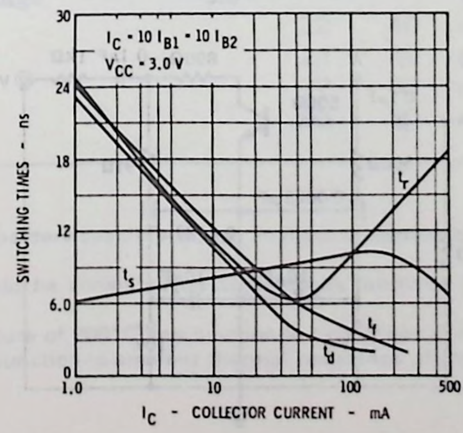
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



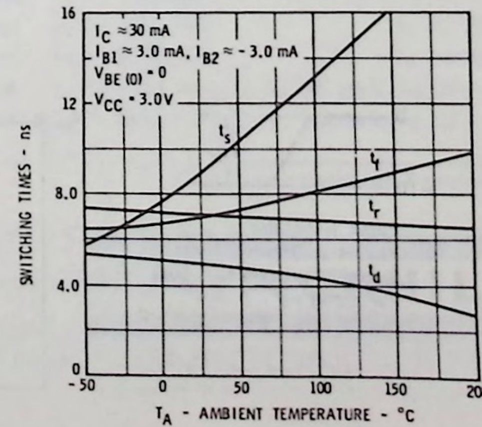
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



SWITCHING TIMES VERSUS COLLECTOR CURRENT

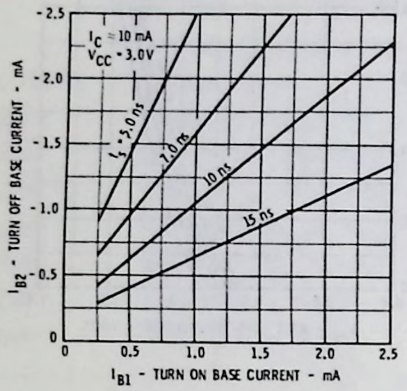


SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

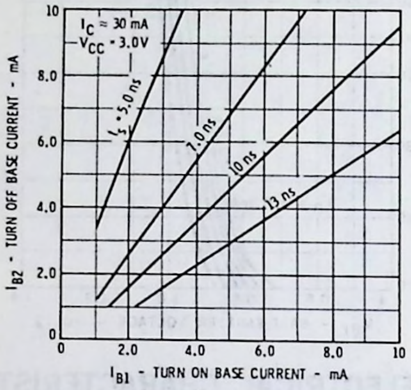


TYPICAL SWITCHING CHARACTERISTICS

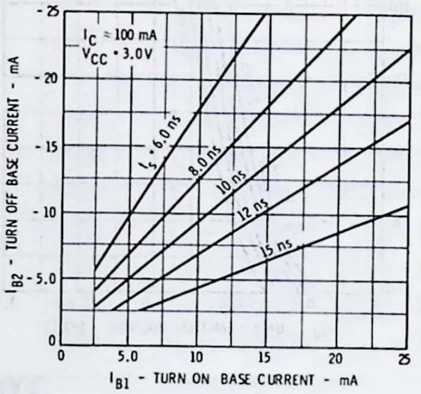
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



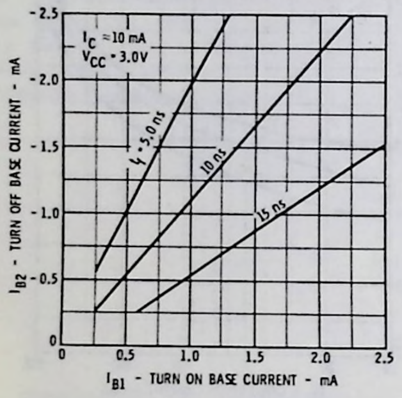
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



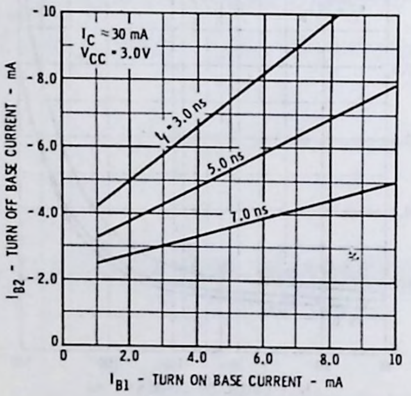
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



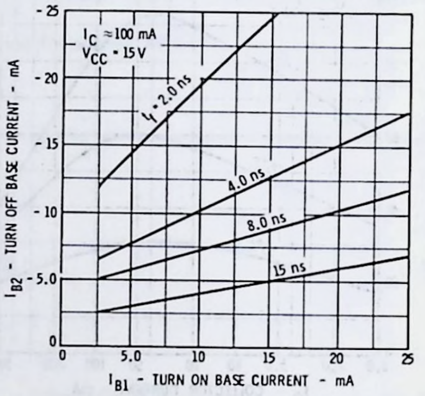
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



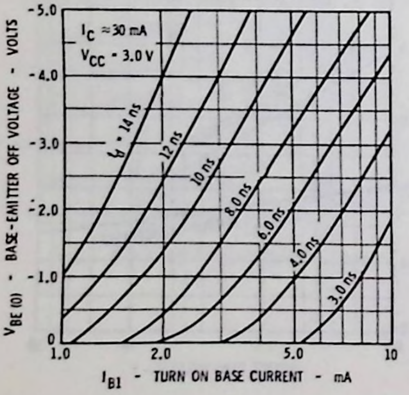
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



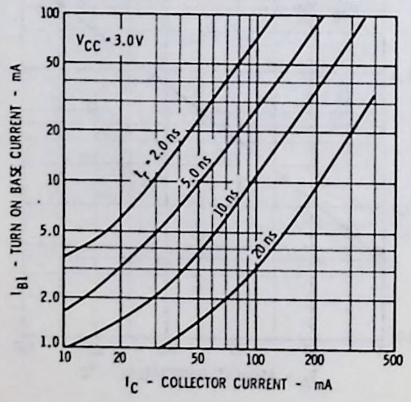
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



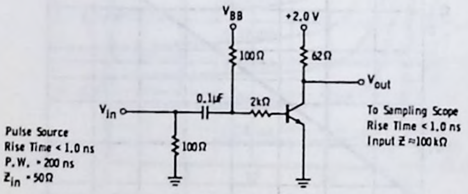
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



t_{ON} AND t_{OFF} TEST CIRCUIT


V_{BB}
+2.0 V
100Ω
62Ω
V_{out}
0.1μF
2kΩ
V_{in}
100Ω

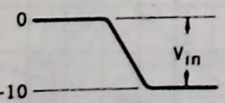
Pulse Source
Rise Time < 1.0 ns
P.W. = 200 ns
$Z_{in} = 50Ω$

To Sampling Scope
Rise Time < 1.0 ns
Input Z ≈ 100 kΩ

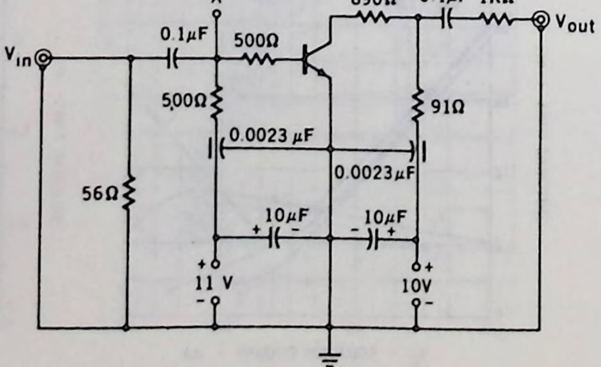
t_{on}
$V_{CC} = +2.0$ V
V_{BB} = Grounded
$V_{in} = +7.0$ V

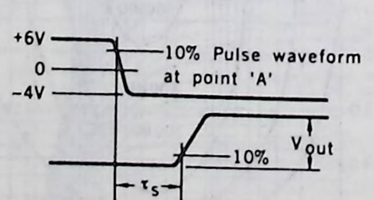
t_{off}
$V_{CC} = +2.0$ V
$V_{BB} = +7.0$ V
$V_{in} = -13$ V

CHARGE STORAGE TIME MEASUREMENT CIRCUIT



Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %


'A'
0.1μF
500Ω
890Ω
0.1μF
1kΩ
V_{out}
V_{in}
500Ω
91Ω
0.0023μF
0.0023μF
56Ω
10μF
10μF
+
-
-
+
+
11 V
-
+
10V
-


+6V
0
-4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_s

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

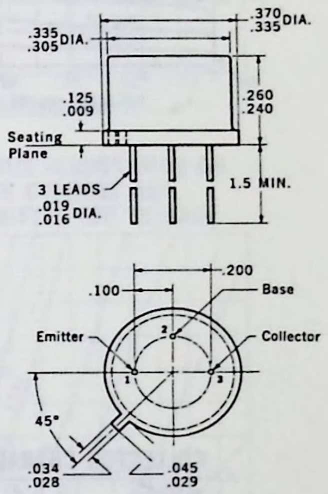
2N3015

FAIRCHILD NPN DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

HIGH SPEED SATURATED SWITCH

The 2N3015 is an NPN double-diffused silicon PLANAR epitaxial transistor designed primarily for high-speed commercial switching applications at collector currents to 500 milliamperes and collector voltages to 60 volts. It is an excellent core driver with switching times guaranteed at 300 and 500 mA, and an LV_{CEO} of 30 volts.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	3.0 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.8 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	60 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	30 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	63	120		$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	10	50			$I_C = 300$ mA	$V_{CE} = 0.7$ V
V_{CE} (sat)	Collector Saturation Voltage [pulsed, see Note 5]		0.23	0.4	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE} (sat)	Collector Saturation Voltage [pulsed, see Note 5]		0.46	1.0	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE} (sat)	Base Saturation Voltage [pulsed, see Note 5]		0.85	1.2	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{BE} (sat)	Base Saturation Voltage [pulsed, see Note 5]		1.12	1.6	Volts	$I_C = 500$ mA	$I_B = 50$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz	2.5	3.3			$I_C = 50$ mA	$V_{CE} = 10$ V
I_{CES}	Collector Reverse Current		0.05	0.2	μA	$V_{BE} = 0$	$V_{CE} = 30$ V
I_{CBO} (125°C)	Collector Cutoff Current		6.5	200	μA	$I_E = 0$	$V_{CB} = 30$ V
C_{obo}	Output Capacitance		5.0	8.0	pF	$I_E = 0$	$V_{CB} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	60			Volts	$I_C = 100$ μA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	30			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_E = 100$ μA	$I_C = 0$
t_{on}	Turn On Time [Note 6]		22	40	nsec	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{on}	Turn On Time [Note 6]		22	40	nsec	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA
t_{off}	Turn Off Time [Note 6]		22	60	nsec	$I_C \approx 300$ mA, $I_{B1} \approx 30$ mA, $I_{B2} \approx -30$ mA	
t_{off}	Turn Off Time [Note 6]		22	60	nsec	$I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA	

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/watt (derating factor of 17.2 mW/°C). Junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.6 mW/°C).

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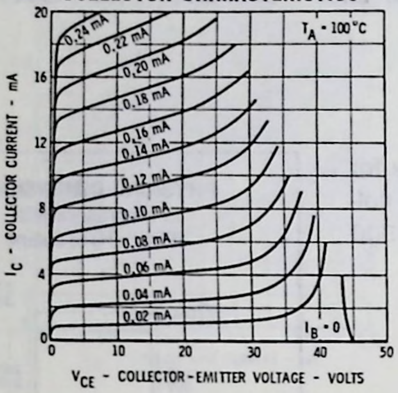
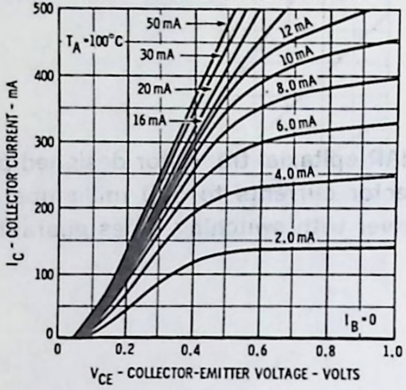
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

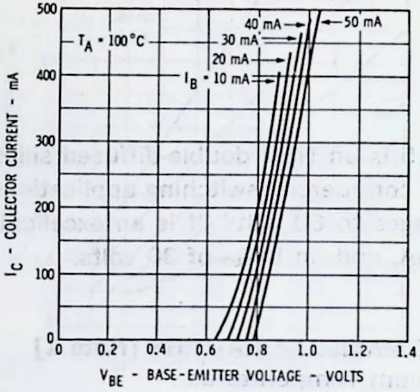
COLLECTOR CHARACTERISTICS*



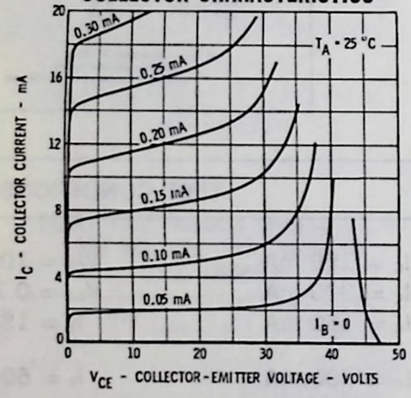
COLLECTOR CHARACTERISTICS*



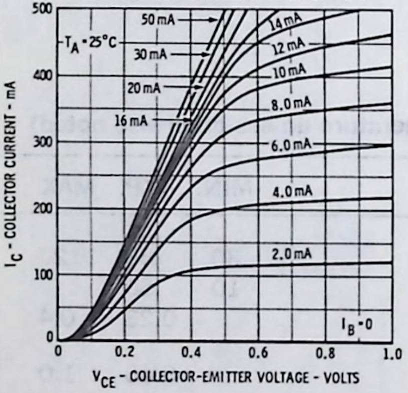
BASE CHARACTERISTICS*



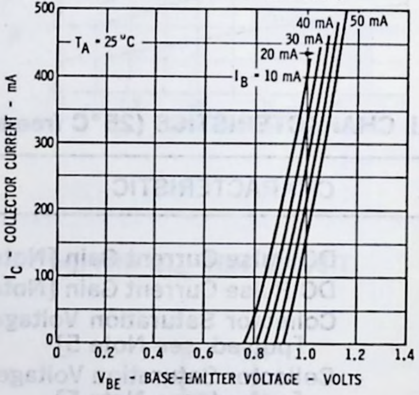
COLLECTOR CHARACTERISTICS*



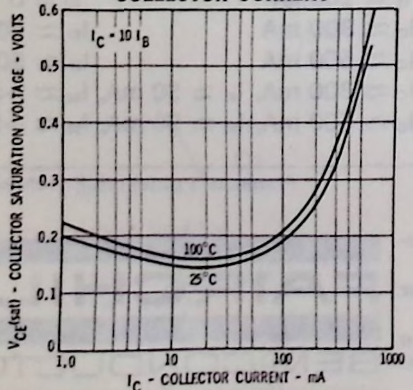
COLLECTOR CHARACTERISTICS*



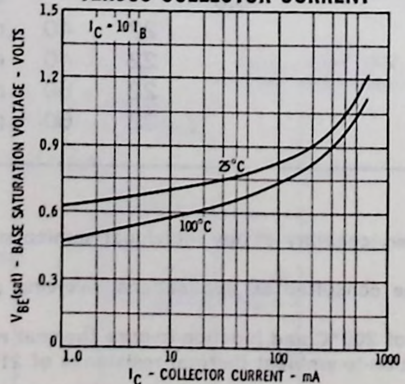
BASE CHARACTERISTICS*



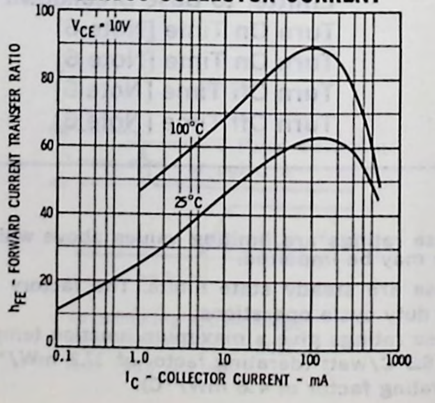
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



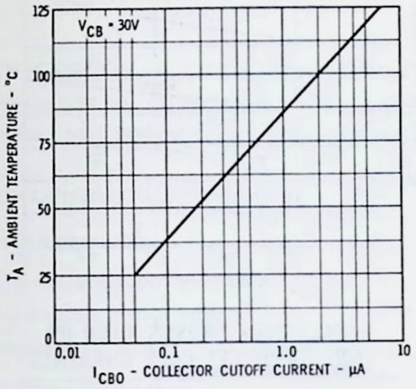
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



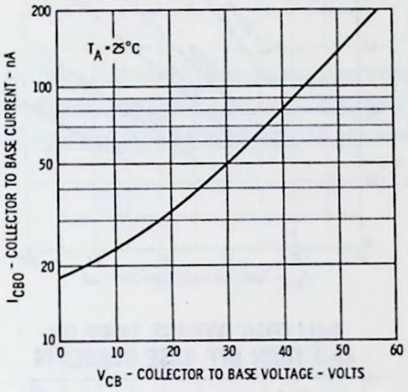
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

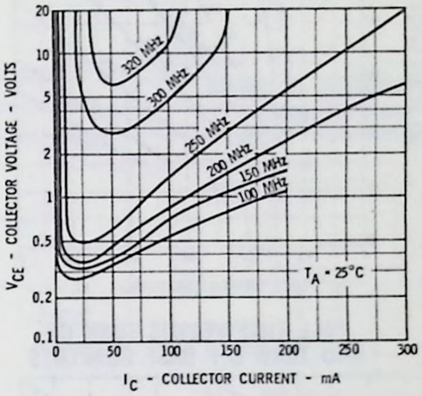
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



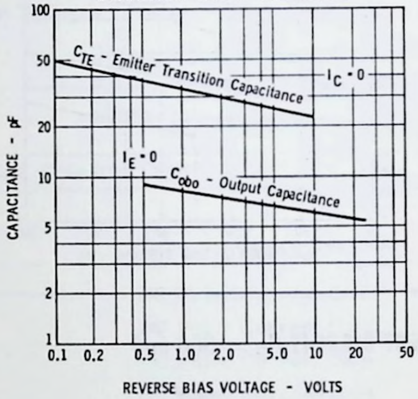
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



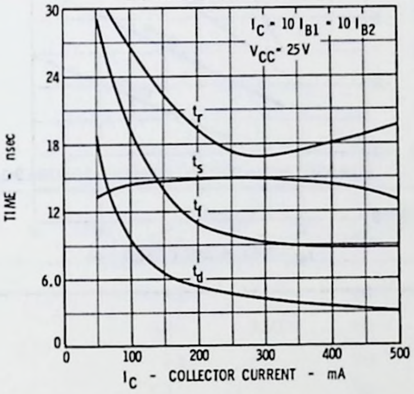
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



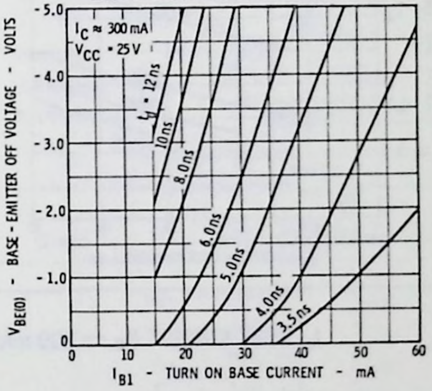
EMITTER TRANSISTION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



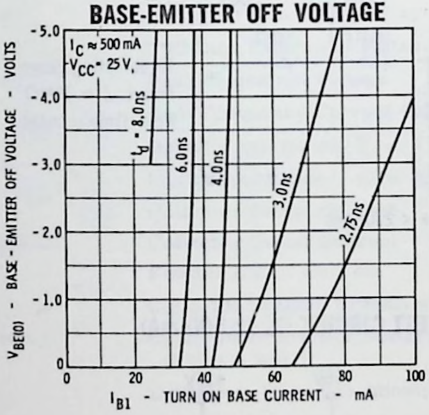
SWITCHING TIMES VERSUS COLLECTOR CURRENT



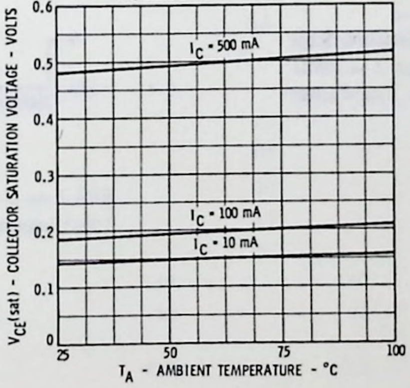
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



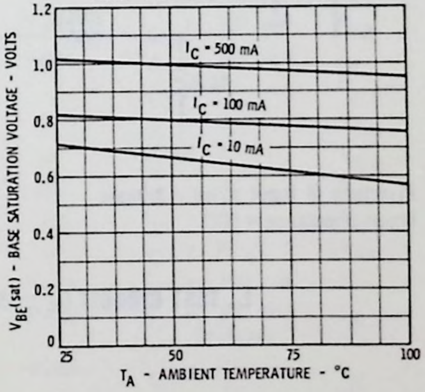
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



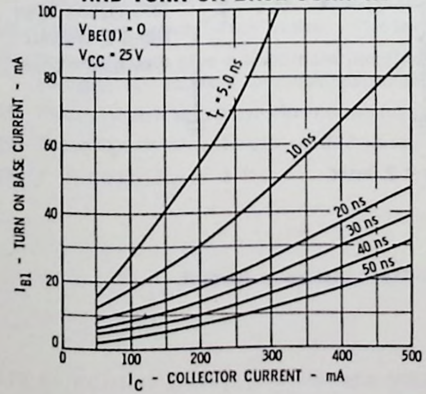
COLLECTOR SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE AND COLLECTOR CURRENT



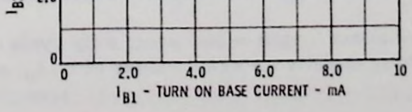
BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE AND COLLECTOR CURRENT



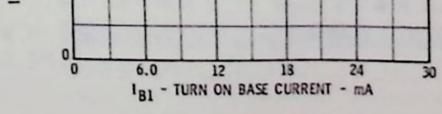
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

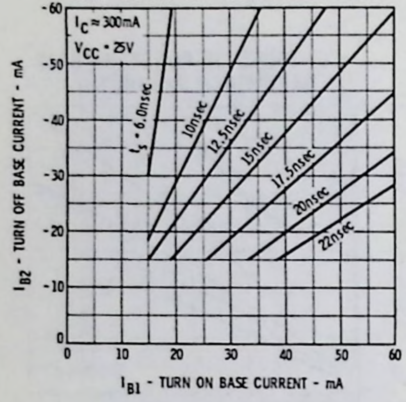


STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

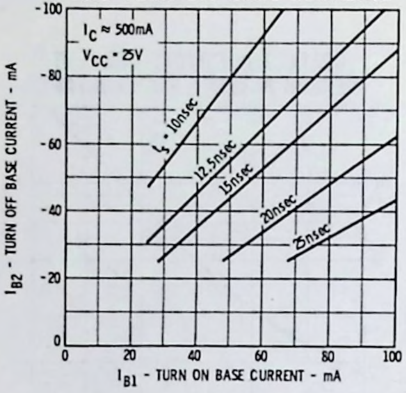


TYPICAL SWITCHING CHARACTERISTICS

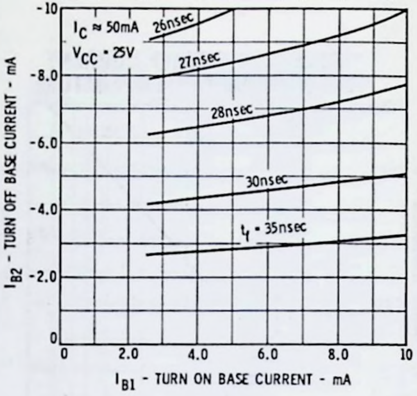
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



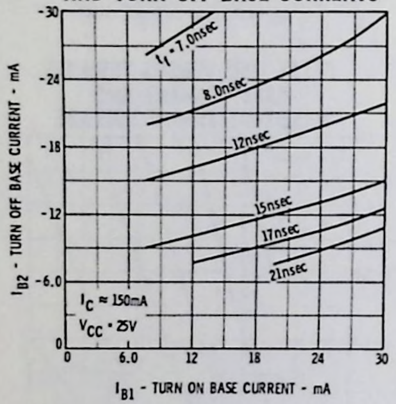
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



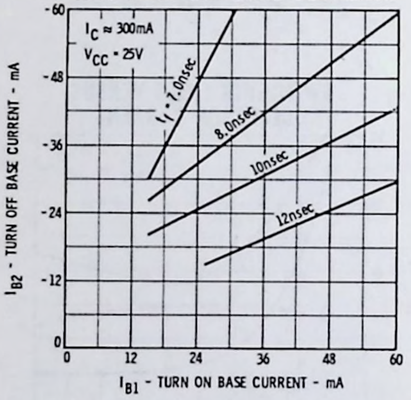
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



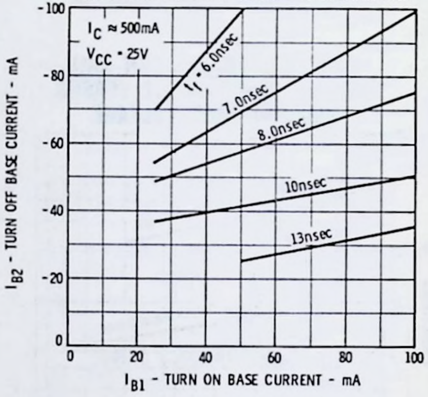
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



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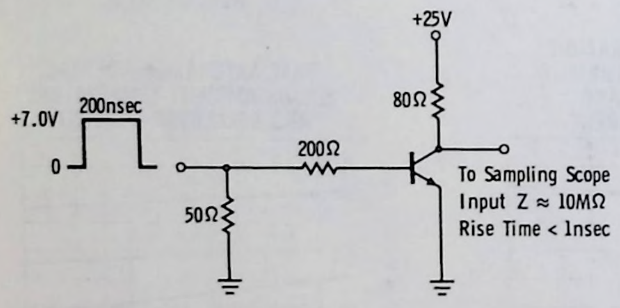
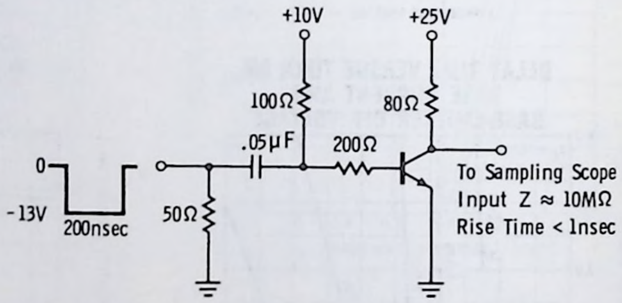
t_{on} TEST CIRCUIT ($I_C \approx 300$ mA)


+25V
80Ω
+7.0V
200nsec
0
200Ω
50Ω
To Sampling Scope
Input Z ≈ 10MΩ
Rise Time < 1nsec

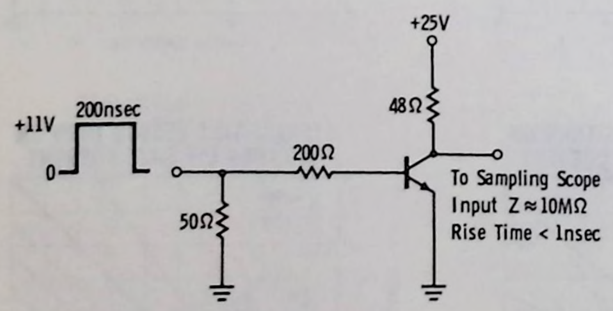
Rise time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

t_{off} TEST CIRCUIT ($I_C \approx 300$ mA)


+10V
+25V
100Ω
80Ω
.05μF
200Ω
0
-13V
200nsec
50Ω
To Sampling Scope
Input Z ≈ 10MΩ
Rise Time < 1nsec

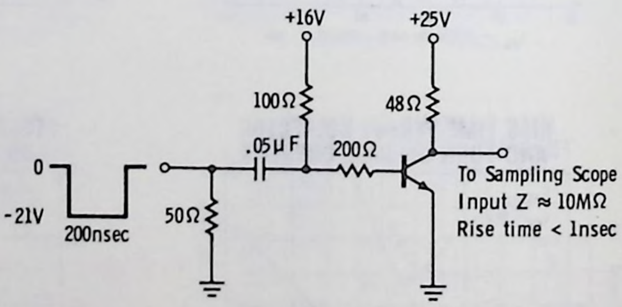
Rise Time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

t_{on} TEST CIRCUIT ($I_C \approx 500$ mA)


+25V
48Ω
+11V
200nsec
0
200Ω
50Ω
To Sampling Scope
Input Z ≈ 10MΩ
Rise Time < 1nsec

Rise time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

t_{off} TEST CIRCUIT ($I_C \approx 500$ mA)


+16V
+25V
100Ω
48Ω
.05μF
200Ω
0
-21V
200nsec
50Ω
To Sampling Scope
Input Z ≈ 10MΩ
Rise time < 1nsec

Rise time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

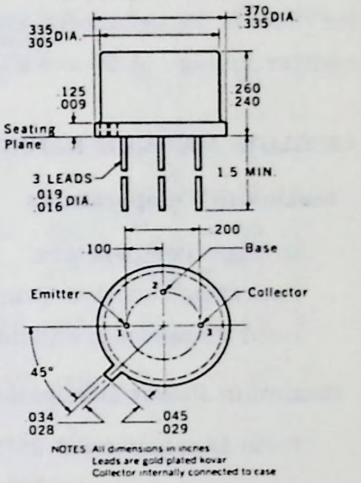
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

2N3019 • 2N3020
NPN HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS
DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The 2N3019 and 2N3020 are NPN Silicon Planar Epitaxial Transistors designed primarily for amplifier and switching applications. These devices feature high breakdown voltages, low leakage currents, low capacity and a beta useful over an extremely wide current range. Switching operation at 1.0 ampere is permissible due to the low saturation voltage.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, No Time Limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	5.0 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.8 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		140 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	80 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3019 Min.	2N3019 Max.	2N3020 Min.	2N3020 Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	90		40	120		I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	100	300	40	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain	50		30	100		I_C = 0.1 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	50		30	100		I_C = 500 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	15		15			I_C = 1.0 A	V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	40					I_C = 150 mA	V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.2		0.2	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.5		0.5	Volts	I_C = 500 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.1		1.1	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 Mc)	5.0		4.0			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance (f = 1 Mc)		12		12	pf	I_E = 0	V_{CB} = 10 V
C_{ibo}	Input Capacitance (f = 1 Mc)		60		60	pf	I_C = 0	V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		10		10	nA	I_E = 0	V_{CB} = 90 V
I_{CBO}(150°C)	Collector Cutoff Current		10		10	μA	I_E = 0	V_{CB} = 90 V
I_{EBO}	Emitter Cutoff Current		10		10	nA	I_C = 0	V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	140		140		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	80		80		Volts	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		Volts	I_C = 0	I_E = 100 μA
$r_b'C_c$	Collector-Base Time Constant (f = 4 Mc)		400		400	psec	I_C = 10 mA	V_{CB} = 10 V
NF	Noise Figure (Note 6)		4			db	I_C = 100 μA	V_{CE} = 10 V

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 350°C/Watt (derating factor of 28.6 mW/°C; junction-to- ambient thermal resistance of 218°C/Watt (derating factor of 4.6 mW/°C.
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle ≤ 1%.
(6) f = 1.0 Kc; R_S = 1 KΩ.

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SEMICONDUCTOR
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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

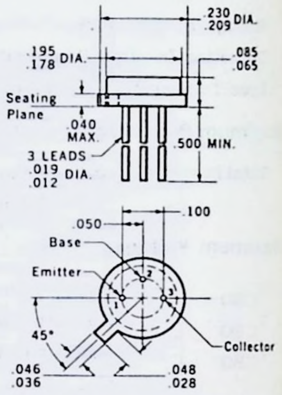
2N3056 · 2N3056A · 2N3057 · 2N3057A

NPN HIGH-VOLTAGE, HIGH-CURRENT AMPLIFIERS

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - These devices are NPN silicon Planar epitaxial transistors designed for use in high-current amplifier applications. Operation to one ampere plus collector to emitter voltage of 60 and 80 volts is permissible.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)	+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	5.0 Watts
at 100°C Case Temperature	(Notes 2 and 3)	2.8 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.4 Watt

Maximum Voltages and Current			2N3056 2N3057	2N3056A 2N3057A
V_{CBO}	Collector to Base Voltage		100 Volts	140 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	60 Volts	80 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts	7.0 Volts
I_C	Continuous Collector Current	(Note 2)	1.0 Amp	1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3056 2N3056A Min.	Max.	2N3057 2N3057A Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	100	300		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	90			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain	30	100	50			I_C = 100 μA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	100	50			I_C = 500 mA	V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)			40			I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	15		15			I_C = 1.0 A	V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage (pulsed, see Note 5)		1.1		1.1	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	30	200	80	400		I_C = 1.0 mA	V_{CE} = 5.0 V
C_{obo}	Open Circuit Output Capacitance		12		12	pf	I_E = 0	V_{CB} = 10 V
C_{ibo}	Open Circuit Input Capacitance		60		60	pf	I_C = 0	V_{EB} = 0.5 V
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		Volts	I_E = 100 μA	I_C = 0
I_{EBO}	Emitter Cutoff Current		10		10	nA	I_C = 0	V_{EB} = 5.0 V
NF	Noise Figure (Note 6)				4.0	db	I_C = 100 μA	V_{CE} = 10 V

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3056 2N3057		2N3056A 2N3057A		Units	Test Conditions
		Min.	Max.	Min.	Max.		
BV_{CBO}	Collector to Base Breakdown Voltage	100		140		Volts	I_C = 100 µA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60		80		Volts	I_C = 30 mA I_B = 0 (pulsed)
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.25		0.2	Volts	I_C = 150 mA I_B = 15 mA (pulsed)
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.7		0.5	Volts	I_C = 500 mA I_B = 50 mA (pulsed)
I_{CBO}	Collector Cutoff Current		10			nA	I_E = 0 V_{CB} = 60 V
I_{CBO}	Collector Cutoff Current				10	nA	I_E = 0 V_{CB} = 90 V
I_{CBO}(150°C)	Collector Cutoff Current		10			µA	I_E = 0 V_{CB} = 60 V
I_{CBO}(150°C)	Collector Cutoff Current				10	µA	I_E = 0 V_{CB} = 90 V
$r_b'C_c$	Collector-Base Time Constant (f = 4.0 MHz)		400	25	400	psec	I_C = 10 mA V_{CB} = 10 V
h_{fe}	High Frequency Current Gain (2N3056 only) (f = 20 MHz)	4.0					I_C = 50 mA V_{CE} = 10 V
h_{fe}	High Frequency Current Gain (2N3056A only) (f = 20 MHz)			4.0	10		I_C = 50 mA V_{CE} = 10 V
h_{fe}	High Frequency Current Gain (2N3057 only) (f = 20 MHz)	5.0					I_C = 50 mA V_{CE} = 10 V
h_{fe}	High Frequency Current Gain (2N3057A only) (f = 20 MHz)			5.0	10		I_C = 50 mA V_{CE} = 10 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/watt (derating factor of 28.6 mW/°C); junction-to-ambient thermal resistance of 438°C/watt (derating factor of 2.28 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

(6) f = 1.0 KHz, R_G = 1.0 KΩ.

2N3072 · 2N3073

PNP VHF AMPLIFIERS, HIGH CURRENT SWITCHES

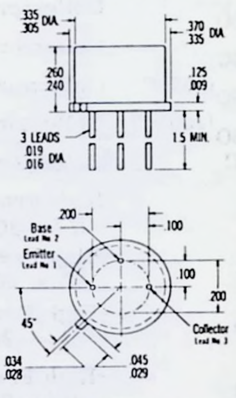
DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

The **2N3072** and **2N3073** are PNP silicon PLANAR epitaxial transistors designed for digital and analog applications at current levels to 500 milliamperes. The high gain-bandwidth product, f_T, at high currents, makes them excellent units for line driving and memory applications.

ABSOLUTE MAXIMUM RATINGS [Note 1]

	2N3072	2N3073
Maximum Temperatures		
Storage Temperature	−65°C to +200°C	−65°C to +200°C
Operating Junction Temperature	200°C Maximum	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum	300°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	3.0 Watts	1.2 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.8 Watt	0.36 Watt
Maximum Voltages and Current		
V_{CBO} Collector to Base Voltage	−60 Volts	−60 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	−60 Volts	−60 Volts
V_{EBO} Emitter to Base Voltage	−4.0 Volts	−4.0 Volts
I_C Collector Current [Note 2]	500 mA	500 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

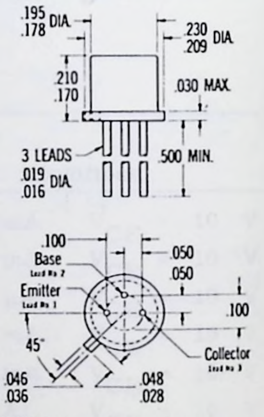
2N3072

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	67	130		$I_C = 50$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	15	43			$I_C = 300$ mA	$V_{CE} = -2.0$ V
V_{BE} (sat)	Base Saturation Voltage		−0.9	−1.2	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{BE} (sat)	Base Saturation Voltage		−1.25	−2.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{CE} (sat)	Collector Saturation Voltage		−0.08	−0.25	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{CE} (sat)	Collector Saturation Voltage		−0.33	−1.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	1.3	2.0			$I_C = 50$ mA	$V_{CE} = -20$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	−60			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
t_{on}	Turn On Time [Note 6]		17	40	nsec	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	Turn Off Time [Note 6]		40	100	nsec	$I_C \approx 300$ mA,	$I_{B1} \approx 30$ mA, $I_{B2} \approx -30$ mA

Additional Electrical Characteristics on page 2.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

2N3073

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C) for the 2N3072 and 146°C/Watt (derating factor of 6.85 mW/°C) for the 2N3073. Junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C for the 2N3072 and 486°C/Watt (derating factor of 2.1 mW/°C) for the 2N3073.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μSec; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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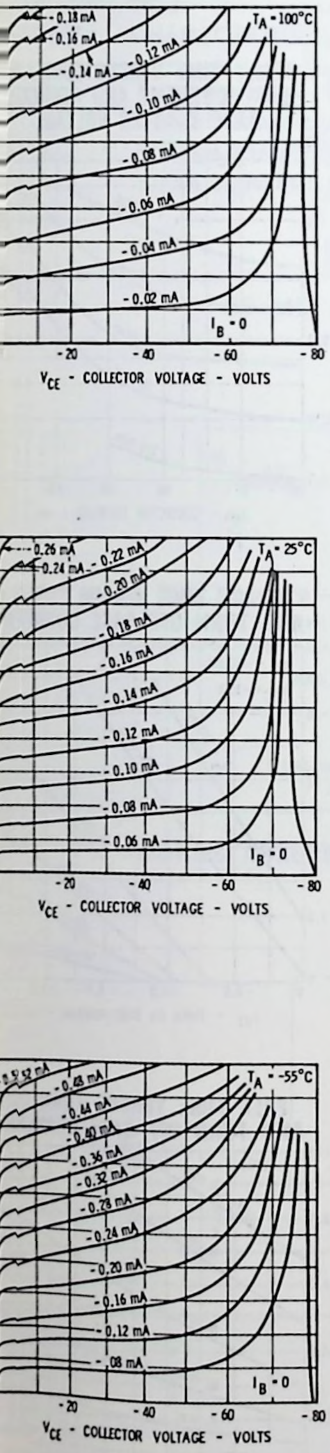
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

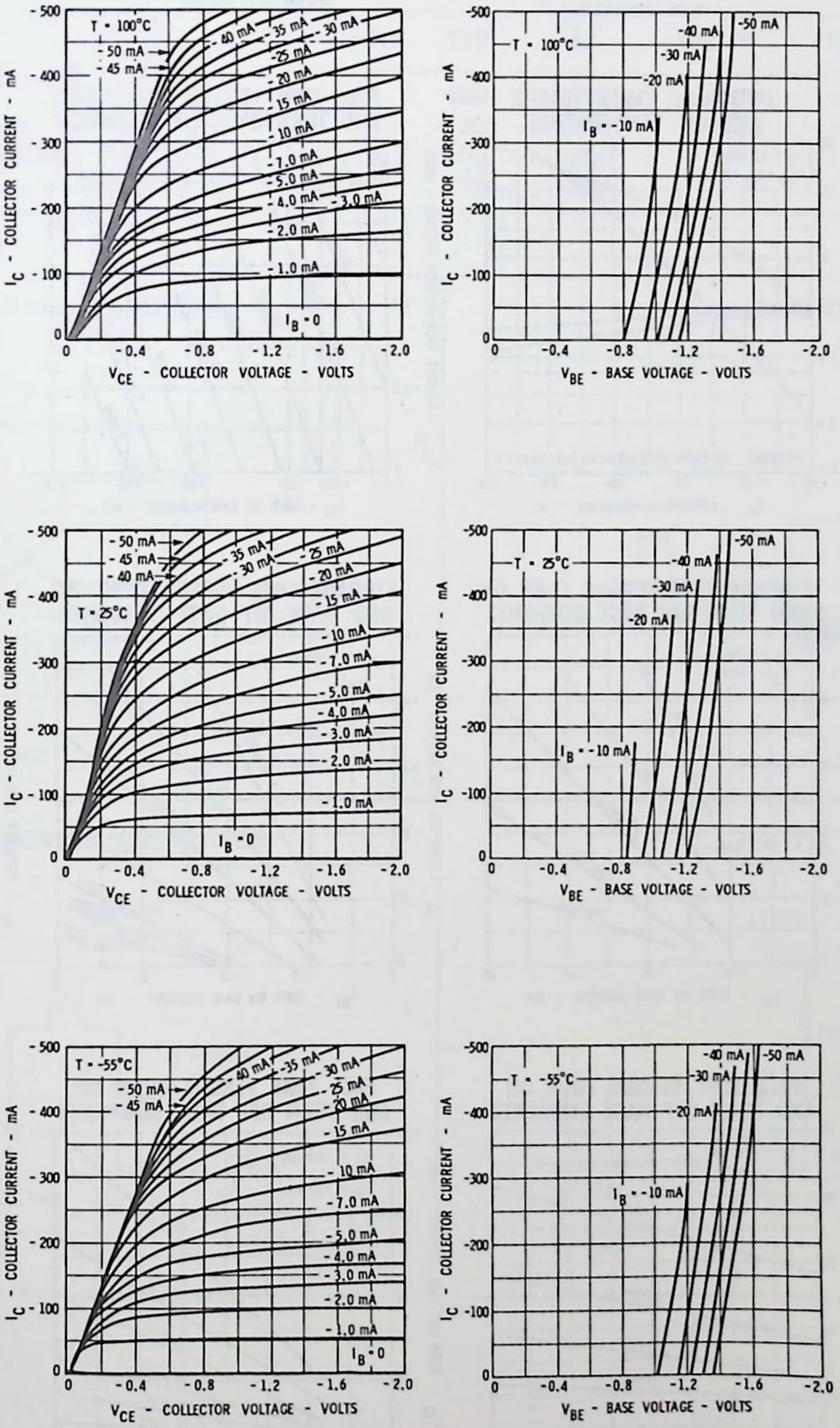
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12	35			$I_C = 50$ mA	$V_{CE} = -1.0$ V
C_{ob}	Output Capacitance		7.0	10	pf	$I_E = 0$	$V_{CB} = -10$ V
I_{CES}	Collector Reverse Current		0.033	10	nA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CES} (125°C)	Collector Reverse Current		0.3	10	μA	$V_{CE} = -30$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−60			Volts	$I_C = 100$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	$I_E = 100$ μA	$I_C = 0$

TYPICAL COLLECTOR AND BASE CHARACTERISTICS *

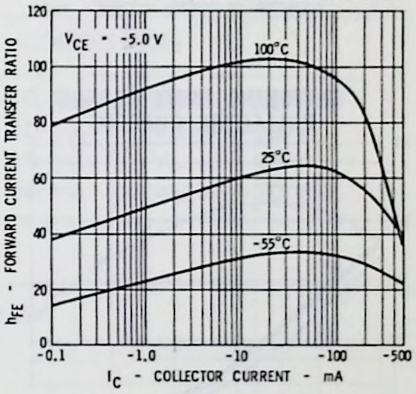
ACTIVE REGION



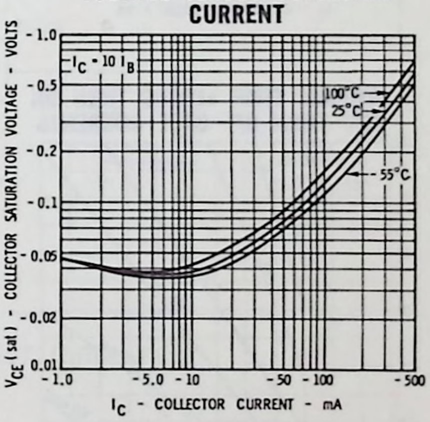
SATURATION REGION



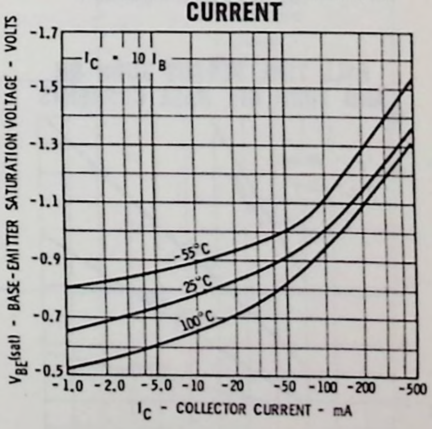
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



PULSED COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



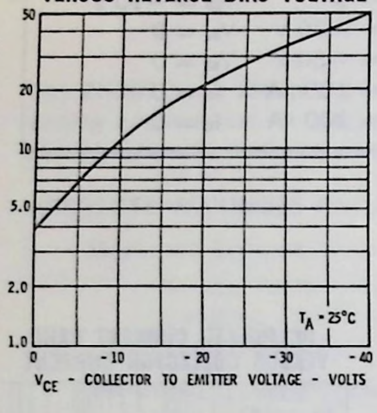
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



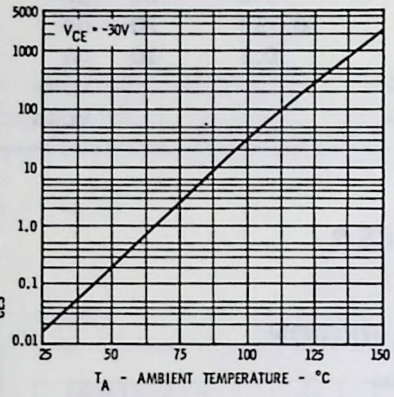
ingle family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

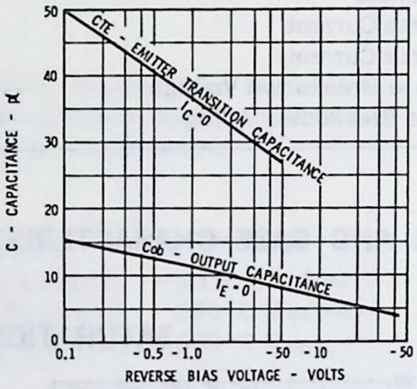
LLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



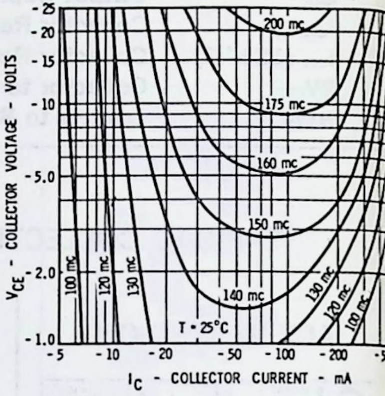
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



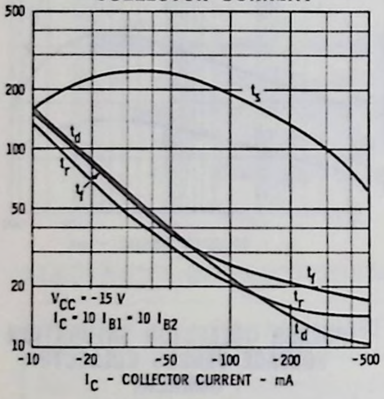
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



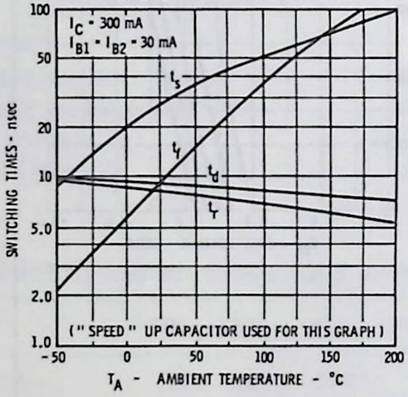
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



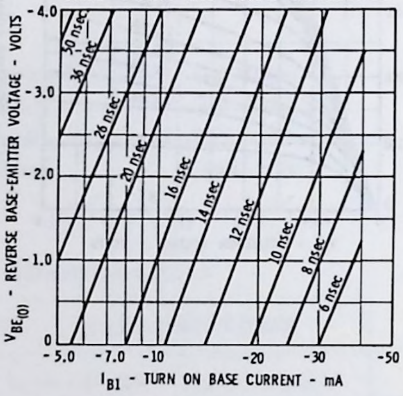
SWITCHING TIMES VERSUS COLLECTOR CURRENT



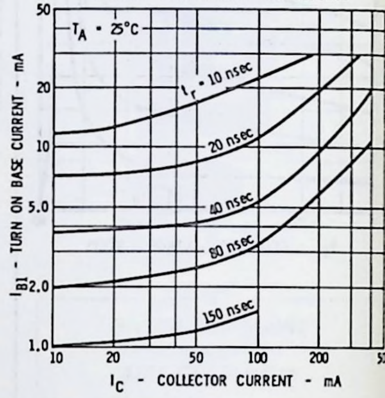
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



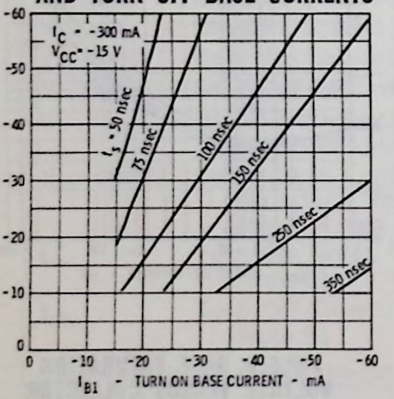
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



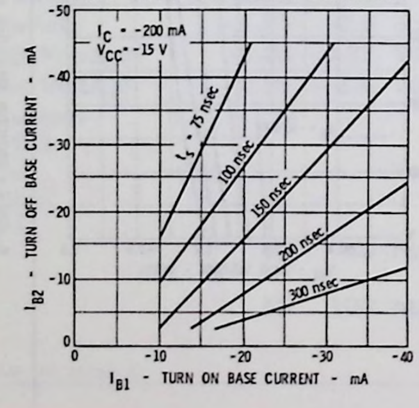
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



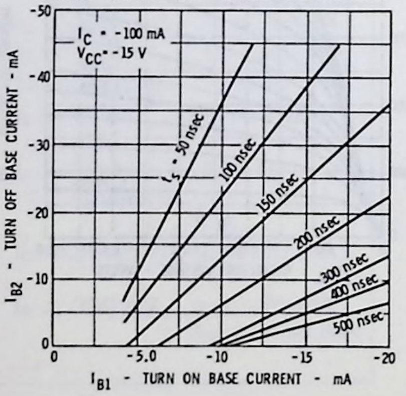
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



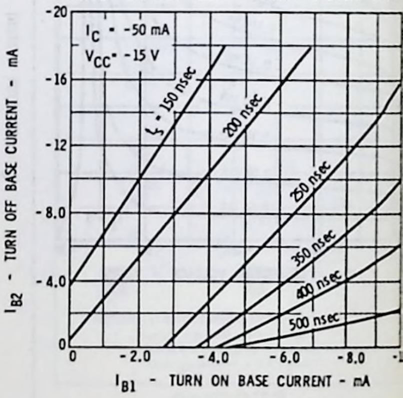
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



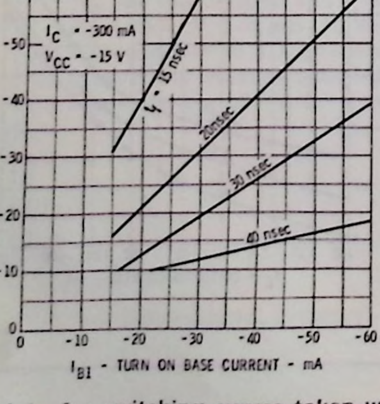
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



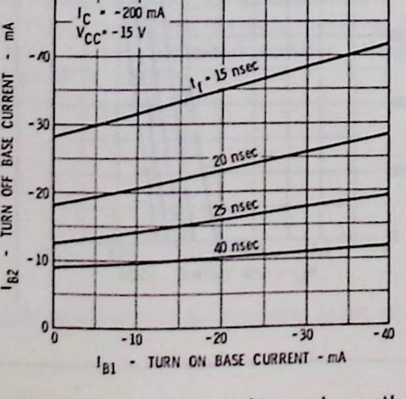
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



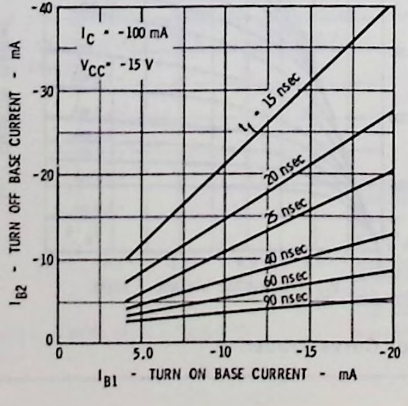
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



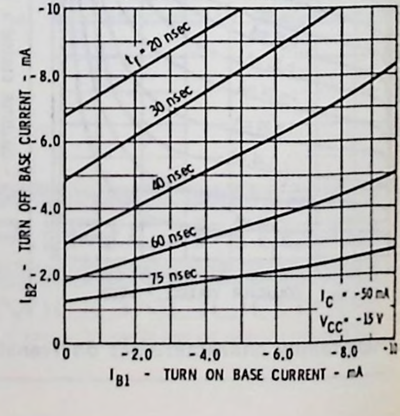
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

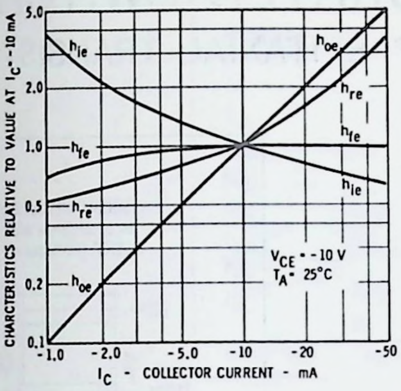


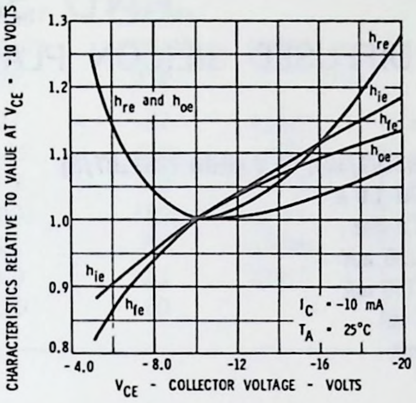
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

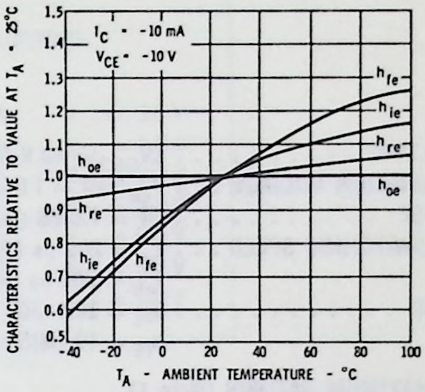


All data for switching curves taken without a "speed-up" capacitor unless otherwise noted.

SMALL SIGNAL CHARACTERISTICS



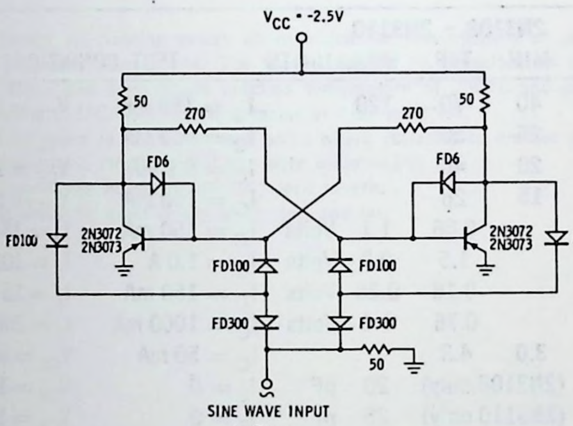




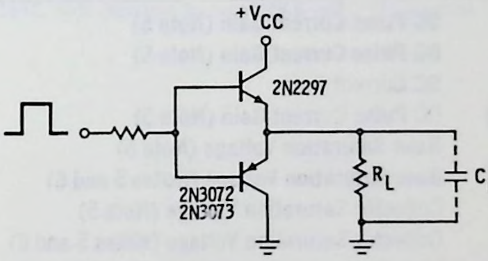
h PARAMETERS (f = 1 kc)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$\lvert h_{ie}\rvert$	Input Resistance		480	1500	ohms	$I_C = 10$ mA	$V_{CE} = -10$ V
$\lvert h_{oe}\rvert$	Output Conductance		80	1200	μmhos	$I_C = 10$ mA	$V_{CE} = -10$ V
$\lvert h_{re}\rvert$	Voltage Feedback Ratio		162	2600	$\times 10^{-6}$	$I_C = 10$ mA	$V_{CE} = -10$ V
$\lvert h_{fe}\rvert$	Small Signal Current Gain	25	74	180		$I_C = 10$ mA	$V_{CE} = -10$ V

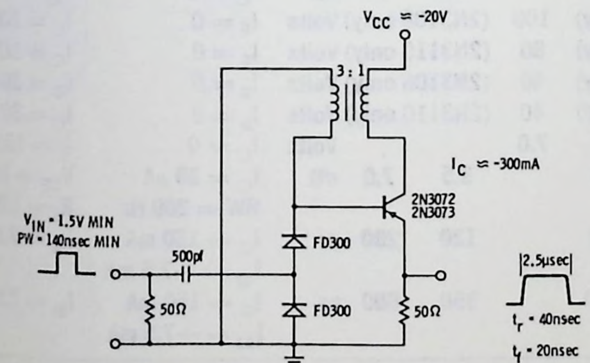
20 MC BINARY COUNTER


VCC = -2.5V
50
270
270
50
FD6
FD6
2N3072
2N3073
FD100
FD100
FD100
2N3072
2N3073
FD100
FD300
FD300
50
SINE WAVE INPUT
f = 20mcs

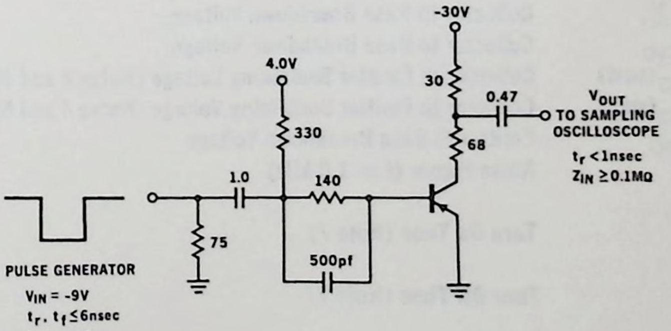
LINE DRIVER


+VCC
2N2297
RL
CL
2N3072
2N3073

MONOSTABLE BLOCKING OSCILLATOR


VCC = -20V
3:1
IC = -300mA
2N3072
2N3073
FD300
VIN = 1.5V MIN
PW = 140nsec MIN
500pf
50Ω
FD300
50Ω
2.5μsec
tr = 40nsec
tf = 20nsec

T$_{ON}$ and T$_{OFF}$ TEST CIRCUIT


-30V
4.0V
30
0.47
VOUT
TO SAMPLING OSCILLOSCOPE
tr < 1nsec
ZIN ≥ 0.1MΩ
330
68
1.0
140
75
500pf
PULSE GENERATOR
VIN = -9V
tr, tf ≤ 6nsec
P.W. = 0.5μsec
ZIN = 50Ω

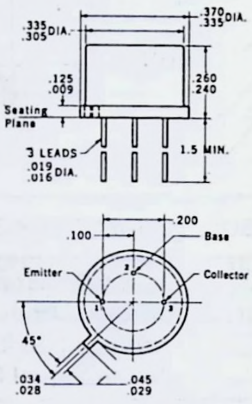
2N3107 • 2N3108 • 2N3109 • 2N3110

NPN HIGH-VOLTAGE, HIGH-CURRENT AMPLIFIERS AND SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE . . . . LV$_{CEO}$ = 40 V (MIN) (2N3109/10); 60 V (MIN) (2N3107/8)**
- **LOW SATURATION VOLTAGE . . . V$_{CE}$(sat) = 1.0 V (MAX) AT 1.0 A**
- **LOW NOISE . . . . NF = 7.0 dB (MAX) AT 1.0 kHz**
- **MEDIUM SWITCHING SPEED . . . t$_{on}$ = 200 ns (MAX) AT 150 mA**
  t$_{off}$ = 600 ns (MAX) AT 150 mA
- **HIGH GAIN . . . . h$_{FE}$ = 100 - 300 AT 150 mA**
  h$_{FE}$ = 40 (MIN) AT 500 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	5.0 Watts
at 25°C Ambient Temperature	0.8 Watt

Maximum Voltages and Current

		2N3107 • 2N3108	2N3109 • 2N3110
V_{CBO}	Collector to Base Voltage	100 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts	40 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts	7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3107 • 2N3109			2N3108 • 2N3110					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	**100**	**190**	**300**	40	70	120		**I_C = 150 mA**	V_{CE} = 1.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**40**	**90**		25	50			**I_C = 500 mA**	V_{CE} = 10 V
h_{FE}	DC Current Gain	35	75		20	40			I_C = 0.1 mA	V_{CE} = 10 V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	30	120		15	26			I_C = 150 mA	V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.86	1.1		0.86	1.1	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage (Notes 5 and 6)		1.5	2.0		1.5	2.0	Volts	I_C = 1.0 A	I_B = 100 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.16	0.25		0.16	0.25	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage (Notes 5 and 6)		0.76	1.0		0.76	1.0	Volts	I_C = 1000 mA	I_B = 100 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.5	10		3.0	4.3			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Open Circuit Output Capacitance	(2N3107 only)		20	(2N3108 only)		20	pF	I_E = 0	V_{CB} = 10 V
C_{obo}	Open Circuit Output Capacitance	(2N3109 only)		25	(2N3110 only)		25	pF	I_E = 0	V_{CB} = 10 V
C_{ibo}	Open Circuit Input Capacitance		62	80		62	80	pF	I_E = 0	V_{EB} = 0.5 V
I_{CES}	Collector Reverse Current		0.4	10		0.4	10	nA	V_{CE} = 60 V	V_{EB} = 0
I_{CBO}(150°C)	Collector Cutoff Current		0.5	10		0.5	10	µA	V_{CB} = 60 V	I_E = 0
I_{EBO}	Emitter Cutoff Current		0.05	10		0.05	10	nA	I_C = 0	V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	100	(2N3107 only)		100	(2N3108 only)		Volts	I_E = 0	I_C = 100 µA
BV_{CBO}	Collector to Base Breakdown Voltage	80	(2N3109 only)		80	(2N3110 only)		Volts	I_E = 0	I_C = 100 µA
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**60**	(2N3107 only)		**60**	(2N3108 only)		**Volts**	I_B = 0	**I_C = 30 mA**
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40	(2N3109 only)		40	(2N3110 only)		Volts	I_B = 0	I_C = 30 mA
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			7.0			Volts	I_C = 0	I_E = 100 µA
NF	**Noise Figure (f = 1.0 kHz)**		**3.5**	**7.0**		**3.5**	**7.0**	**dB**	**I_C = 30 µA** **BW = 200 Hz**	**V_{CE} = 10 V** **R_S = 1.0 kΩ**
t_{on}	**Turn On Time** (Note 7)		120	200		**120**	**200**	ns	**I_C ≈ 150 mA** **I_{B2} ≈ −7.5 mA**	**I_{B1} ≈ 7.5 mA**
t_{off}	**Turn Off Time** (Note 7)			1000		**350**	**600**	ns	**I_C ≈ 150 mA** **I_{B2} ≈ −7.5 mA**	**I_{B1} ≈ 7.5 mA**

*Planar is a patented Fairchild process.

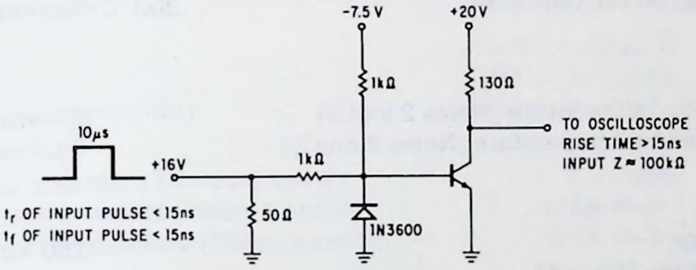
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS 2N3107 THRU 2N3110

TYPICAL SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

SYMBOL	2N3107 2N3109 TYP.	2N3108 2N3110 TYP.	UNITS	CONDITIONS	
h_{ib}	27	27	ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	0.12	0.12	μmhos	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{rb}	1.8	0.5	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ie}	5000	1800	ohms	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	20	8.0	μmhos	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{re}	6.0	2.1	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	170	60		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

SWITCHING CIRCUIT


-7.5 V
+20 V
1kΩ
130Ω
TO OSCILLOSCOPE
RISE TIME > 15ns
INPUT Z ≈ 100kΩ
10μs
+16V
1kΩ
t_r OF INPUT PULSE < 15ns
t_f OF INPUT PULSE < 15ns
50Ω
1N3600

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low-duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/Watt (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 218°C/Watt (derating factor of 4.57 mW/°C).

This rating refers to a high-current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

Saturation voltage measured with ¼" lead length.

See test circuit for exact values of I_C, I_{B1}, and I_{B2}.

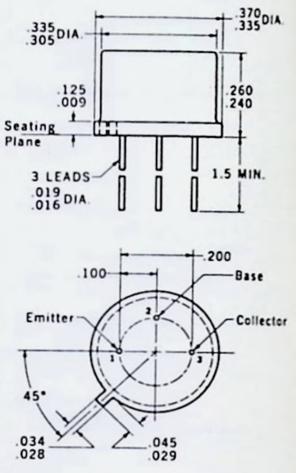
2N3114

NPN HIGH-VOLTAGE AMPLIFIER

DIFFUSED SILICON PLANAR TRANSISTOR

The 2N3114 is an NPN silicon PLANAR transistor primarily designed for high-voltage, medium-power amplifier applications. This device features a guaranteed minimum LV_{CEO} of 150 volts and a minimum f_T of 40 mc, and operates at current levels up to 100 mA.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	5.0 Watts
at 25°C Free Air Temperature [Notes 2 and 3]	0.8 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	150 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	150 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	60	120		$I_C = 30$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	15	35			$I_C = 100\ \mu$A	$V_{CE} = 10$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12	24			$I_C = 30$ mA	$V_{CE} = 10$ V
V_{BE} (sat)	Base Saturation Voltage		0.8	0.9	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.3	1.0	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CBO}	Collector Cutoff Current		0.3	10	nA	$I_E = 0$	$V_{CB} = 100$ V
I_{CBO} (150°C)	Collector Cutoff Current		2.7	10	μA	$I_E = 0$	$V_{CB} = 100$ V
I_{EBO}	Emitter Cutoff Current			100	nA	$I_C = 0$	$V_{EB} = 4.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kc)	25	50			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 mc)	2.0	2.7			$I_C = 30$ mA	$V_{CE} = 10$ V
C_{ob}	Output Capacitance		6.0	9.0	pf	$I_E = 0$	$V_{CB} = 20$ V
C_{TE}	Emitter Transition Capacitance		70	80	pf	$I_C = 0$	$V_{EB} = 0.5$ V
R_e (h_{ie})	Real Part of Input Impedance (f = 100 mc)			30	ohms	$I_C = 10$ mA	$V_{CE} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	150			Volts	$I_C = 100\ \mu$A	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	150			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_E = 100\ \mu$A	$I_C = 0$

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/watt (derating factor of 28.6 mW/°C); junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.56 mW/°C).
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.
(5) Pulse conditions: Length = 300 μsec; duty cycle = 1%.

2N3117

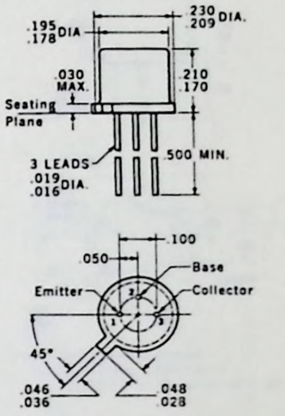
NPN VERY LOW-NOISE, LOW-LEVEL TYPE

DIFFUSED SILICON PLANAR TRANSISTOR

he 2N3117 is an NPN double-diffused silicon PLANAR transistor designed for use in high-erformance, low-level, low-noise amplifiers from dc to 60 mc.

he very-low-noise characteristic over a wide range of source resistance makes this device ideal r transducer amplifiers. Also, high-beta at collector currents down to one microampere permits icrowatt operation in applications where power supply drain is a factor, such as, solar cell ower sources.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

BSOLUTE MAXIMUM RATINGS [Note 7]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 8 and 9]	1.2 Watts
at 100°C Case Temperature [Notes 8 and 9]	0.68 Watt
at 25°C Ambient Temperature [Notes 8 and 9]	0.36 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	60 Volts
V_{CEO} Collector to Emitter Voltage [Note 6]	60 Volts
V_{EBO} Emitter to Base Voltage	6.0 Volts
I_C Collector Current	50 mA

LECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted).

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	250		500		$I_C = 10\ \mu A$	$V_{CE} = 5.0\ V$
h_{FE}	DC Current Gain	400				$I_C = 1.0\ mA$	$V_{CE} = 5.0\ V$
h_{FE}	DC Current Gain	300				$I_C = 100\ \mu A$	$V_{CE} = 5.0\ V$
h_{FE}	DC Current Gain	100				$I_C = 1.0\ \mu A$	$V_{CE} = 5.0\ V$
h_{FE} (−55°C)	DC Current Gain	50				$I_C = 10\ \mu A$	$V_{CE} = 5.0\ V$
V_{BE} (on)	Emitter-Base On Voltage			0.7	Volts	$I_C = 100\ \mu A$	$V_{CE} = 5.0\ V$
V_{CE} (sat)	Collector Saturation Voltage			0.35	Volts	$I_C = 1.0\ mA$	$I_B = 0.1\ mA$
h_{fe}	High Frequency Current Gain (f = 30 mc)	2.0				$I_C = 0.5\ mA$	$V_{CE} = 5.0\ V$
I_{CBO}	Collector Cutoff Current			10	nA	$I_E = 0$	$V_{CB} = 45\ V$
I_{CBO} (150°C)	Collector Cutoff Current			10	μA	$I_E = 0$	$V_{CB} = 45\ V$
I_{EBO}	Emitter Cutoff Current			10	nA	$I_C = 0$	$V_{EB} = 5.0\ V$
C_{ob}	Output Capacitance			4.5	pf	$I_E = 0$	$V_{CB} = 5.0\ V$
C_{TE}	Emitter Transition Capacitance			6.0	pf	$I_C = 0$	$V_{EB} = 0.5\ V$
BV_{CBO}	Collector to Base Breakdown Voltage	60			Volts	$I_E = 0$	$I_C = 10\ \mu A$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 5 and 6]	60			Volts	$I_C = 10\ mA$ (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
NF	Narrow Band Noise Figure [Note 1]			1.0	db	$I_C = 5.0\ \mu A$	$V_{CE} = 5.0\ V$
NF	Narrow Band Noise Figure [Note 2]			1.0	db	$I_C = 5.0\ \mu A$	$V_{CE} = 5.0\ V$
NF	Narrow Band Noise Figure [Note 3]			4.0	db	$I_C = 30\ \mu A$	$V_{CE} = 5.0\ V$
NF	Narrow Band Noise Figure [Note 4]			15	db	$I_C = 30\ \mu A$	$V_{CE} = 5.0\ V$

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

SMALL SIGNAL CHARACTERISTICS (f=1kc)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	10	18	24	Kohms	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance		15	40	μmho	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio		425	800	$\times 10^{-6}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain	400	620	900		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

NOTES:

(1) R_S = 50 KΩ; f = 10 Kc; Power Bandwidth = 1.0 Kc.

(2) R_S = 50 KΩ; f = 1.0 Kc; Power Bandwidth = 200 cps.

(3) R_S = 10 KΩ; f = 100 cps; Power Bandwidth = 20 cps.

(4) R_S = 10 KΩ; f = 10 cps; Power Bandwidth = 2.0 cps.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1.0%.

(6) These ratings refer to a high-current point where collector-to-emitter voltage is lowest.

(7) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(8) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(9) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).

2N3120 · 2N3121

PNP VHF AMPLIFIERS, HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

he 2N3120 and 2N3121 are PNP silicon PLANAR epitaxial transistors designed for digital and nalog applications at current levels to 500 milliamperes. The high gain-bandwidth product, f_T, at igh currents, makes them excellent units for line driving and memory applications.

BSOLUTE MAXIMUM RATINGS [Note 1]

	2N3120	2N3121
Maximum Temperatures		
Storage Temperature	**−65°C** to **+200°C**	**−65°C** to **+200°C**
Operating Junction Temperature	**200°C** Maximum	**200°C** Maximum
Lead Temperature (Soldering, 60 sec time limit)	**300°C** Maximum	**300°C** Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature [Notes 2 & 3]	**3.0** Watts	**1.2** Watts
at 25°C Ambient Temperature [Notes 2 & 3]	**0.8** Watt	**0.36** Watt

Maximum Voltages and Current

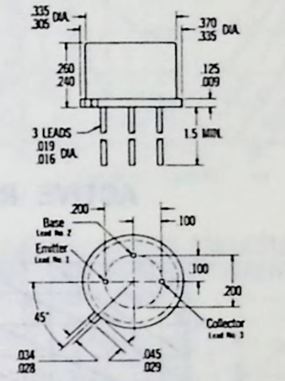
		2N3120	2N3121
V_{CBO}	Collector to Base Voltage	**−45** Volts	**−45** Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	**−45** Volts	**−45** Volts
V_{EBO}	Emitter to Base Voltage	**−4.0** Volts	**−4.0** Volts
I_C	Collector Current [Note 2]	**500** mA	**500** mA

LECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	**30**	**67**	**130**		$I_C = 50$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**15**	**43**			$I_C = 300$ mA	$V_{CE} = -2.0$ V
V_{BE} (sat)	Base Saturation Voltage		**−0.9**	**−1.2**	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{BE} (sat)	Base Saturation Voltage		**−1.35**	**−2.0**	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.08**	**−0.25**	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.6**	**−1.0**	Volts	$I_C = 500$ mA	$I_B = 50$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	**1.3**	**2.0**			$I_C = 50$ mA	$V_{CE} = -20$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	**−45**			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
t_{on}	Turn On Time [Note 6]		**17**	**40**	nSec	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	Turn Off Time [Note 6]		**40**	**100**	nSec	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA $I_{B2} \approx -30$ mA

2N3120

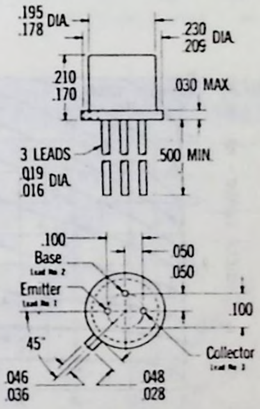
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N3121

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C) for the 2N3120 and 146°C/Watt (derating factor of 6.85 mW/°C) for the 2N3121. Junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C for the 2N3120 and 486°C/Watt (derating factor of 2.1 mW/°C) for the 2N3121.

Rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μSec; duty cycle = 1%.

See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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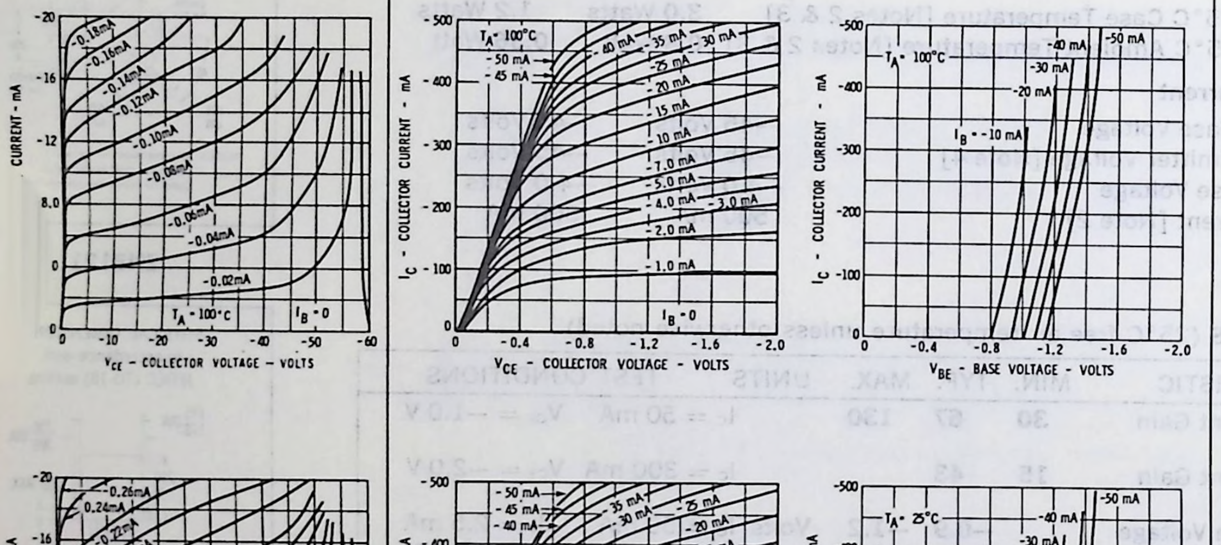
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12	50			$I_C = 50$ mA $V_{CE} = -1.0$ V
V_{CE} (sat)	Collector Saturation Voltage		−0.33	−0.5	Volts	$I_C = 300$ mA $I_B = 30$ mA
C_{ob}	Output Capacitance		7.0	10	pf	$I_E = 0$ $V_{CB} = -10$ V
I_{CES}	Collector Reverse Current		0.033	10	nA	$V_{CE} = -30$ V $V_{BE} = 0$
I_{CES} (125°C)	Collector Reverse Current		0.3	10	μA	$V_{CE} = -30$ V $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−45			Volts	$I_C = 100$ μA $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	$I_E = 100$ μA $I_C = 0$

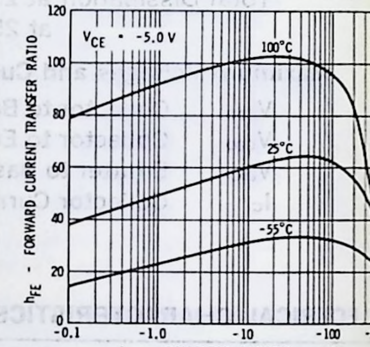
TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

ACTIVE REGION

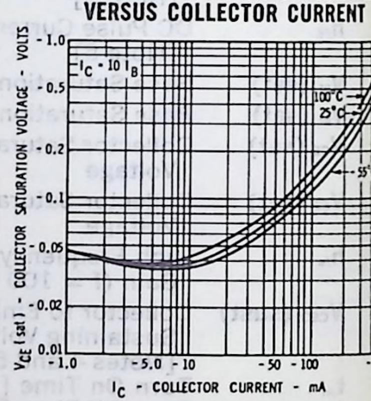
SATURATION REGION



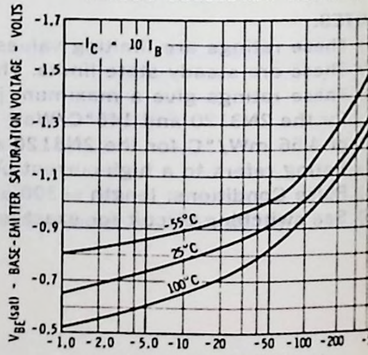
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



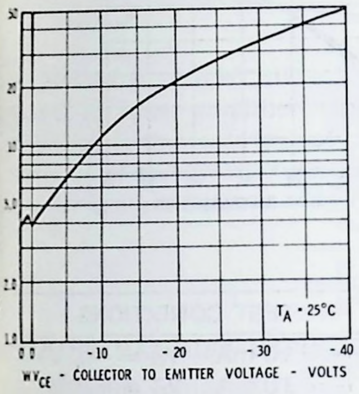
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



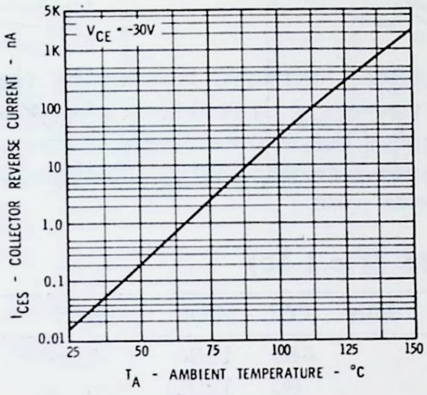
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

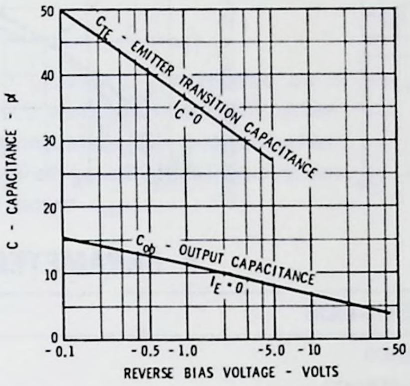
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



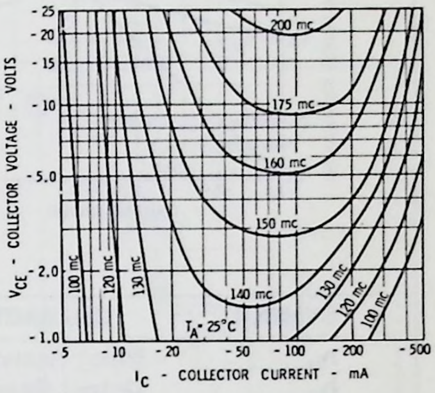
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



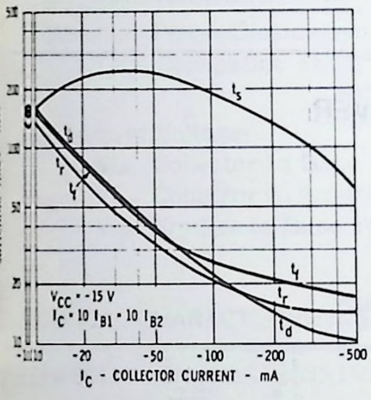
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



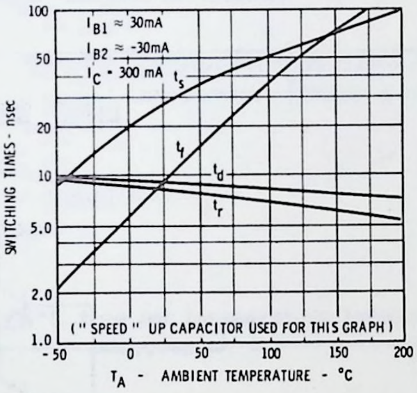
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



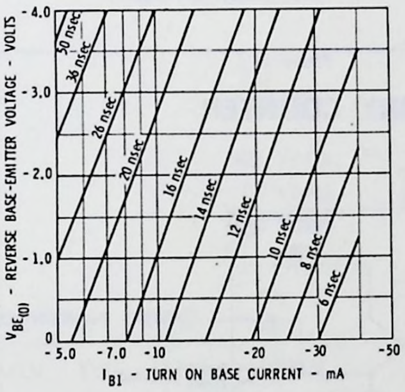
SWITCHING TIMES VERSUS COLLECTOR CURRENT



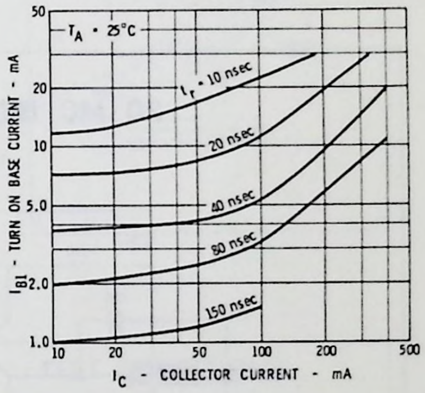
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



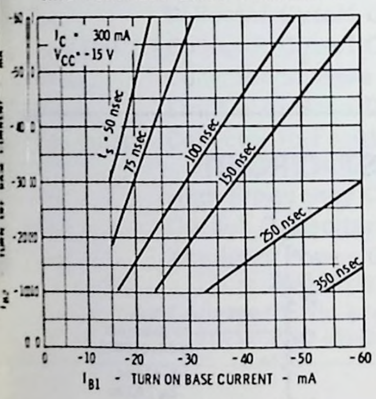
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



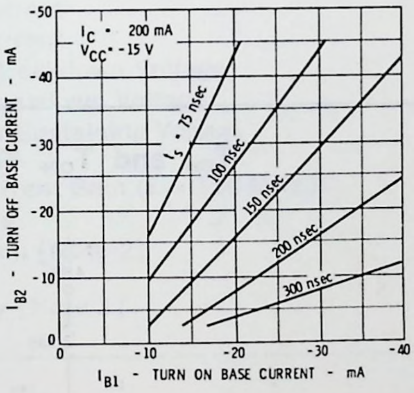
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



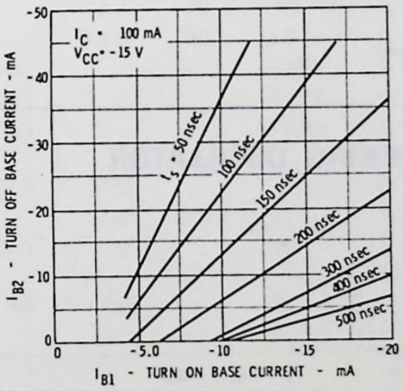
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



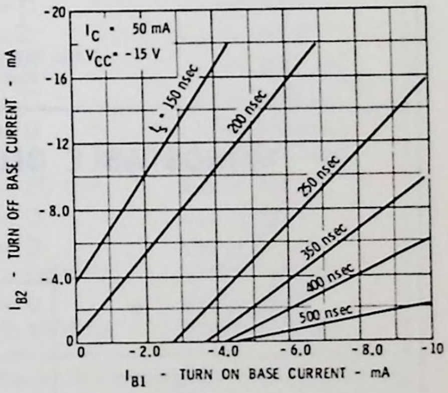
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



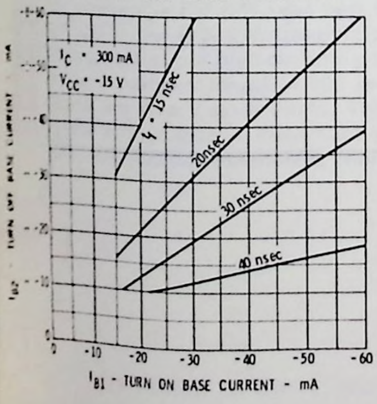
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



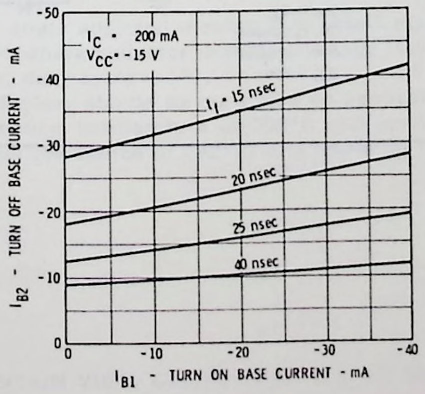
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



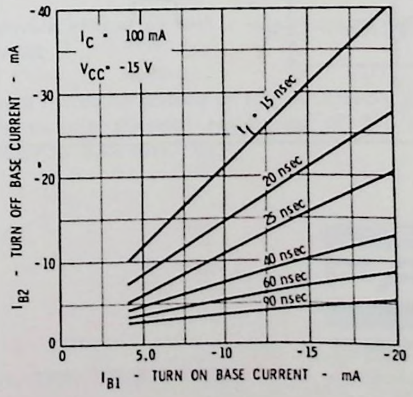
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



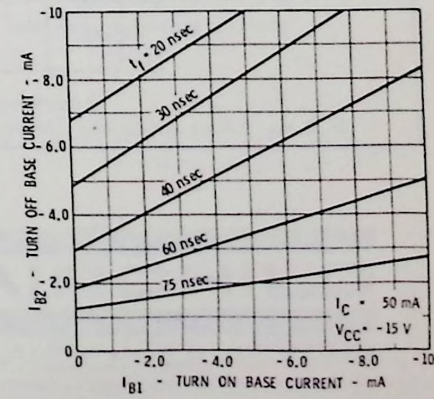
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



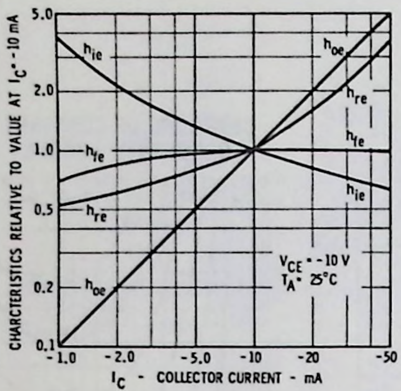
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

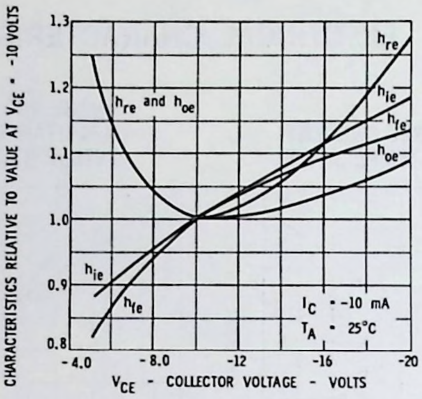


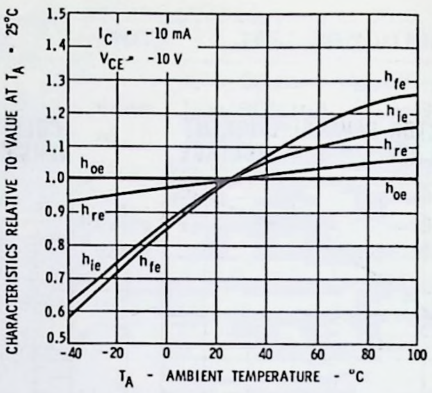
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



SMALL SIGNAL CHARACTERISTICS



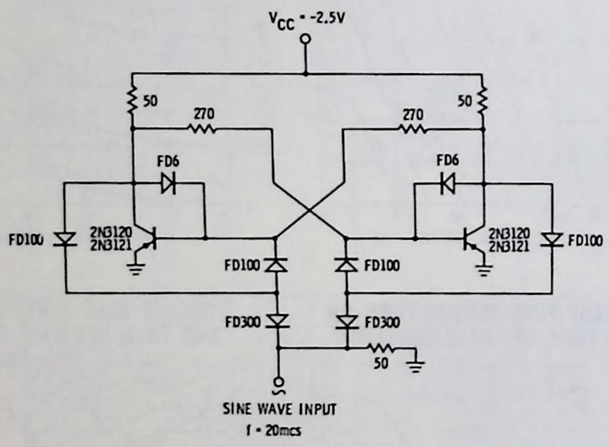




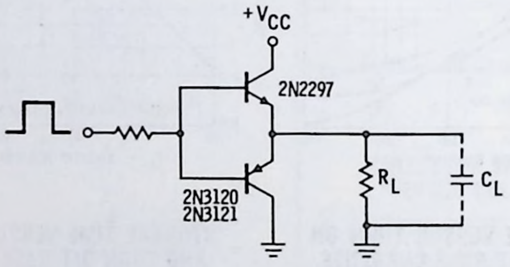
h PARAMETERS (f = 1 kc)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance		480	1500	ohms	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{oe}	Output Conductance		80	1200	μmhos	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{re}	Voltage Feedback Ratio		162	2600	$\times 10^{-6}$	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{fe}	Small Signal Current Gain	25	74	180		$I_C = 10$ mA	$V_{CE} = -10$ V

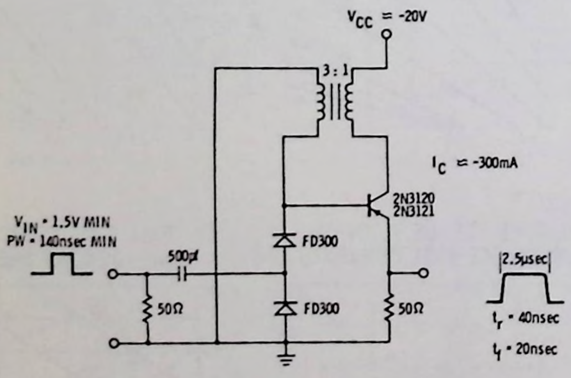
20 MC BINARY COUNTER


VCC = -2.5V
50
50
270
270
FD6
FD6
FD100
2N3120
2N3121
2N3120
2N3121
FD100
FD100
FD100
FD300
FD300
50
SINE WAVE INPUT
f = 20mcs

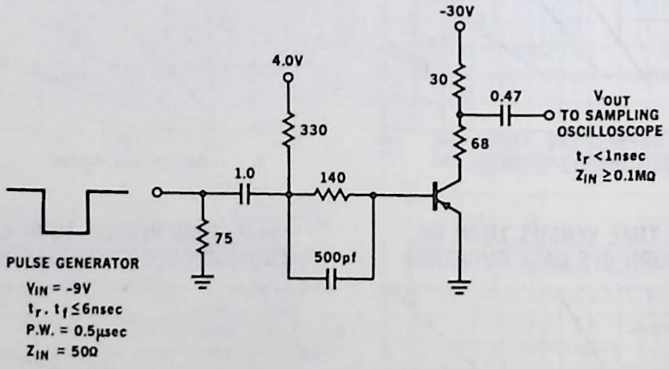
LINE DRIVER


+VCC
2N2297
2N3120
2N3121
RL
CL

MONOSTABLE BLOCKING OSCILLATOR


VCC = -20V
3 : 1
IC = -300mA
2N3120
2N3121
VIN = 1.5V MIN
PW = 140nsec MIN
500pf
FD300
FD300
50Ω
50Ω
2.5μsec
tr = 40nsec
tf = 20nsec

T_{ON} and T_{OFF} TEST CIRCUIT


-30V
4.0V
30
330
0.47
VOUT
TO SAMPLING
OSCILLOSCOPE
68
tr < 1nsec
ZIN ≥ 0.1MΩ
1.0
140
75
500pf
PULSE GENERATOR
VIN = -9V
tr, tf ≤ 6nsec
P.W. = 0.5μsec
ZIN = 50Ω

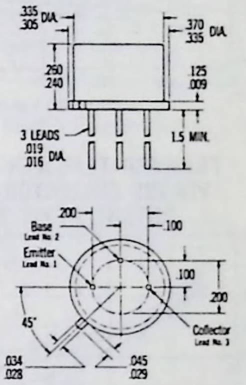
2N3137

NPN CLASS-C RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

he **2N3137** is an NPN silicon PLANAR epitaxial transistor designed primarily for service as a lass-C, RF power amplifier. Power output at 250 MHz is typically 0.5 watt with 100 mW drive. n addition to the large signal capabilities, the low-noise and high gain-bandwidth product charcteristics of the 2N3137 provide excellent performance in a variety of small signal and linear mplifier applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (soldering, 60 sec. time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 6 and 7]	1.0 watt
25°C Ambient Temperature [Notes 6 and 7]	0.6 watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	40 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	20 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts

LECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	20	70	120		$I_C = 50$ mA	$V_{CE} = 5.0$ V
V_{CE} (sat)	Collector Saturation Voltage		0.12	0.3	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CBO}	Collector Cutoff Current		0.12	50	nA	$I_E = 0$	$V_{CB} = 20$ V
I_{CBO} (150°C)	Collector Cutoff Current		0.10	50	μA	$I_E = 0$	$V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	$I_E = 0$	$I_C = 100$ μA
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	$I_C = 0$	$I_E = 100$ μA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	20			Volts	$I_B = 0$	$I_C = 15$ mA (pulsed)
h_{fe}	High Frequency Current Gain (f = 100 MHz)	5.0	7.5			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{obo}	Output Capacitance		2.8	3.5	pF	$I_E = 0$	$V_{CB} = 10$ V
G_{PE}	Amplifier Power Gain [Note 2] ($f_o = 250$ MHz)	6.0	7.0		dB	$I_C = 0$ (zero signal)	$V_{CE} = 20$ V (zero signal)
η	Collector Efficiency [Note 3] ($f_o = 250$ MHz)	40	60		%	$I_C = 0$ (zero signal)	$V_{CE} = 20$ V (zero signal)

* Planar is a patented Fairchild process.

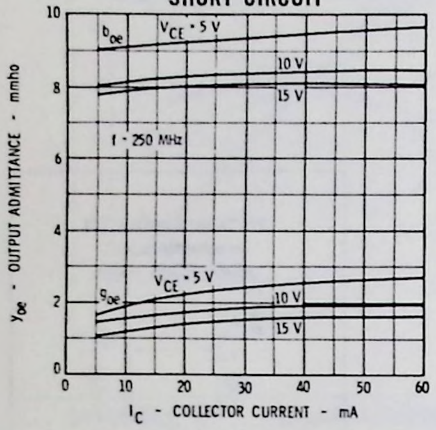
OTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) RF power-in = 100 mW (see test circuit).
3) RF power-in = 100 mW. Conduction angle adjusted through R to obtain maximum efficiency with a minimum of 400 mW out. (See test circuit.)
4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
6) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
7) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 175°C/watt (derating factor of 5.71 mW/°C); junction-to-ambient thermal resistance of 292°C/watt (derating factor of 3.42 mW/°C).

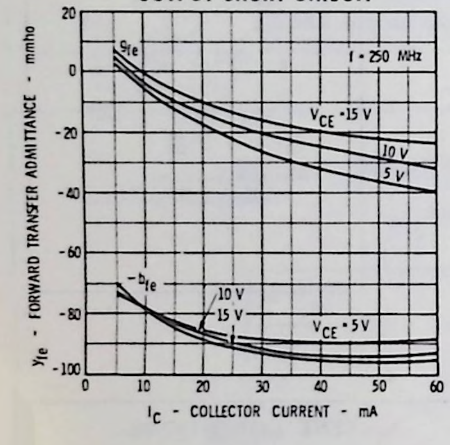
FAIRCHILD TRANSISTOR 2N3137

TYPICAL ELECTRICAL CHARACTERISTICS

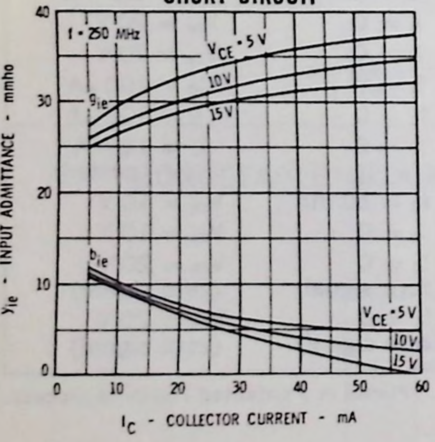
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT



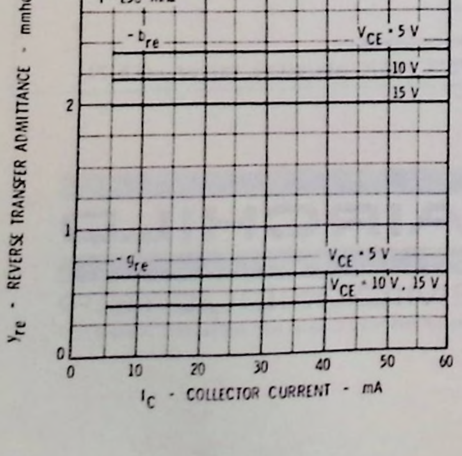
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



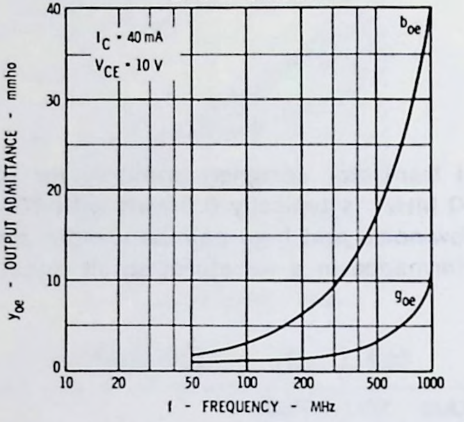
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



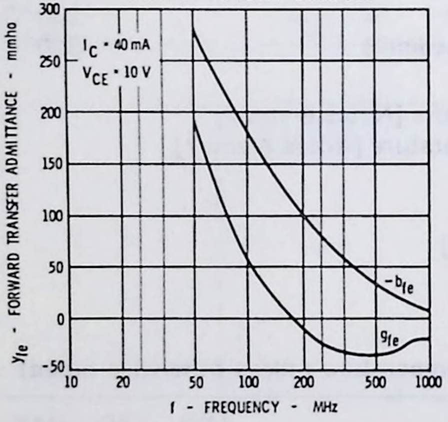
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT



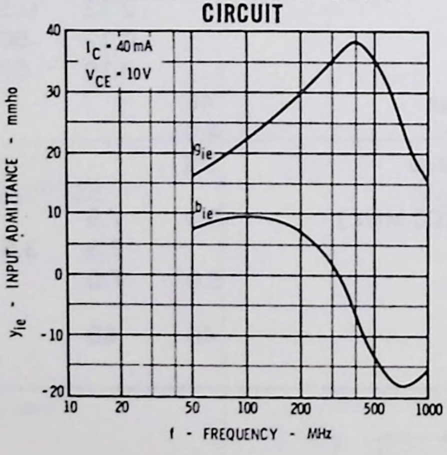
OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



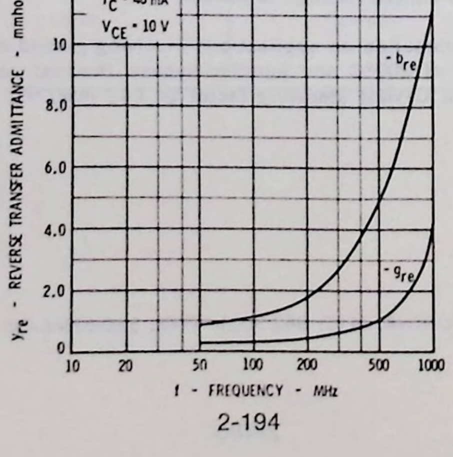
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



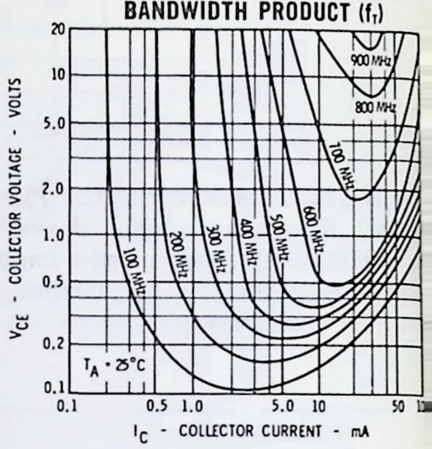
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



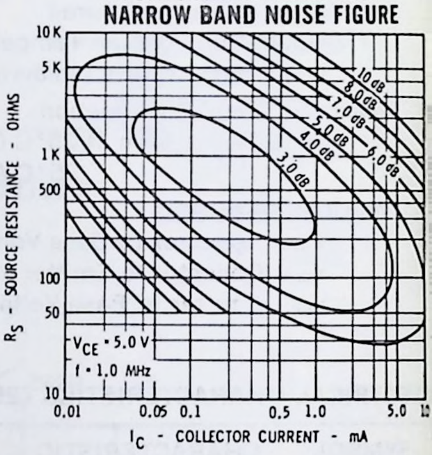
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



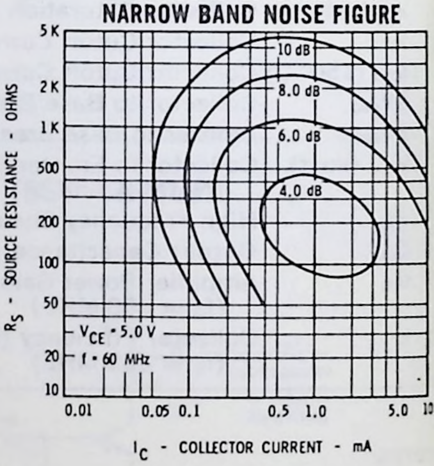
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



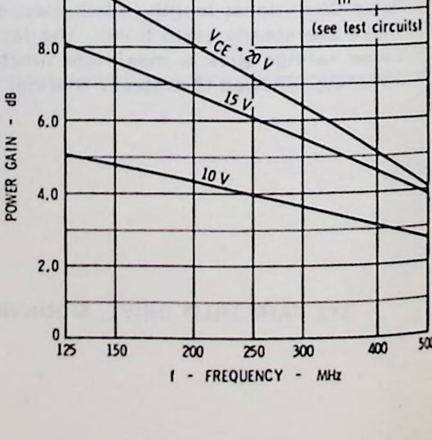
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



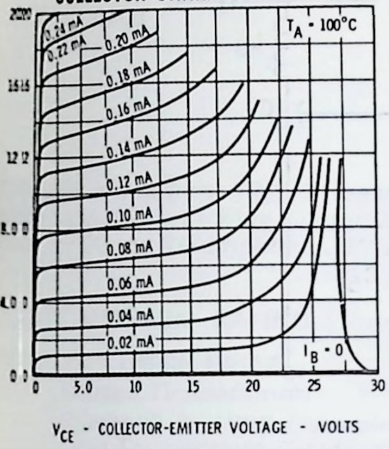
POWER GAIN VERSUS FREQUENCY



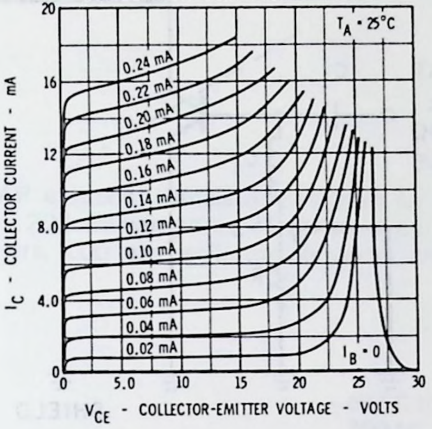
FAIRCHILD TRANSISTOR 2N3137

TYPICAL ELECTRICAL CHARACTERISTICS

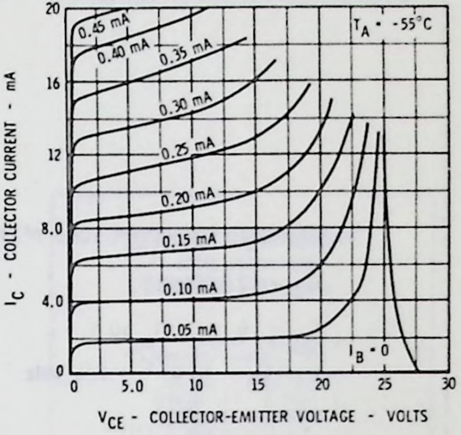
COLLECTOR CHARACTERISTICS



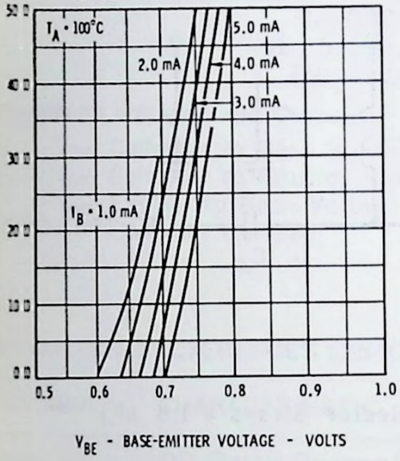
COLLECTOR CHARACTERISTICS



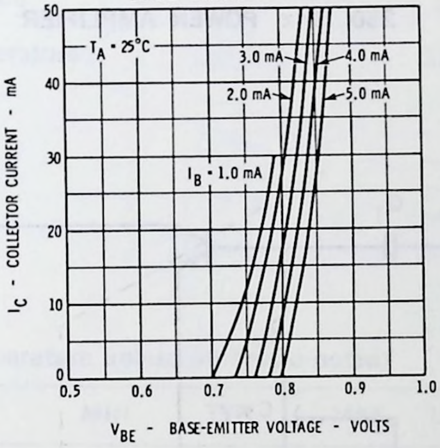
COLLECTOR CHARACTERISTICS



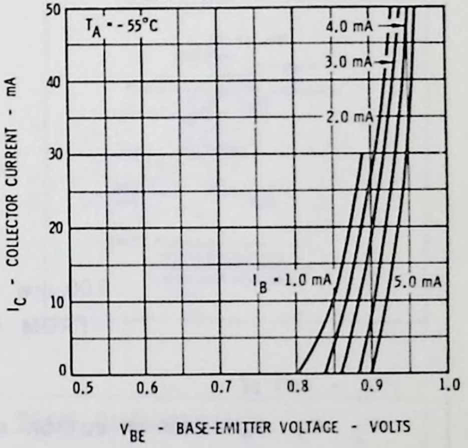
BASE CHARACTERISTICS



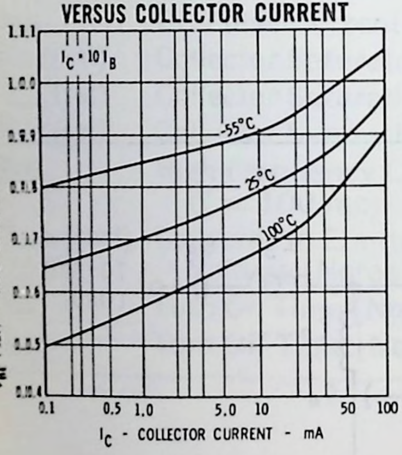
BASE CHARACTERISTICS



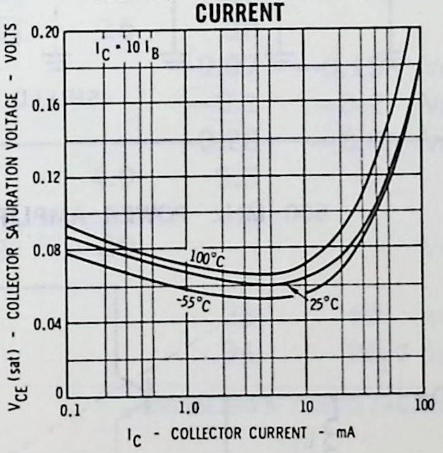
BASE CHARACTERISTICS



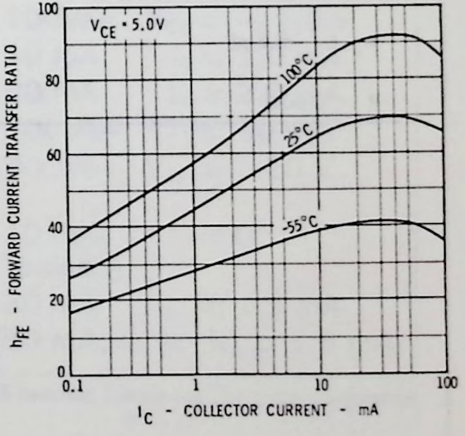
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



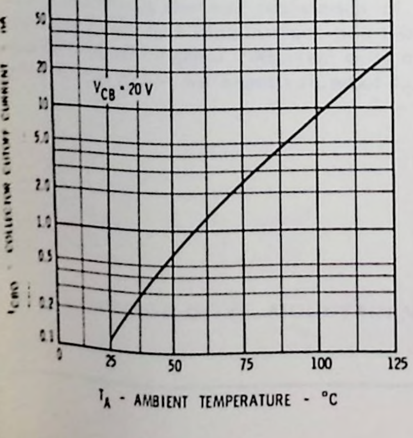
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



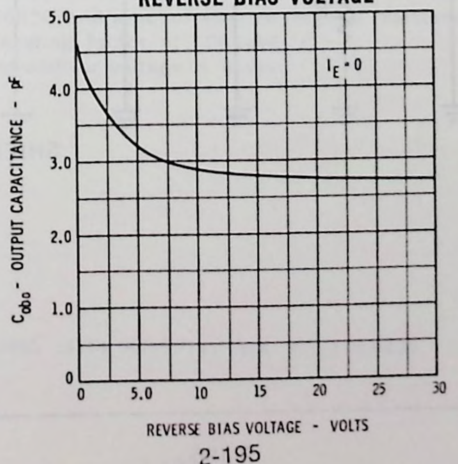
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



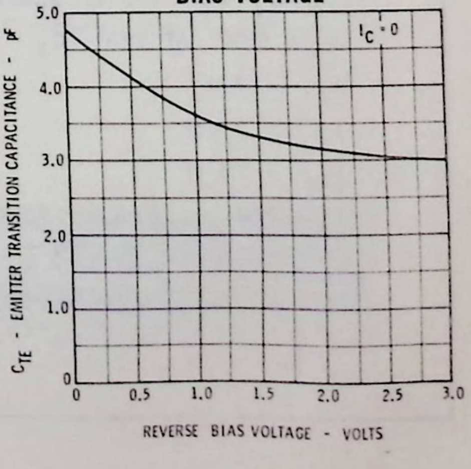
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



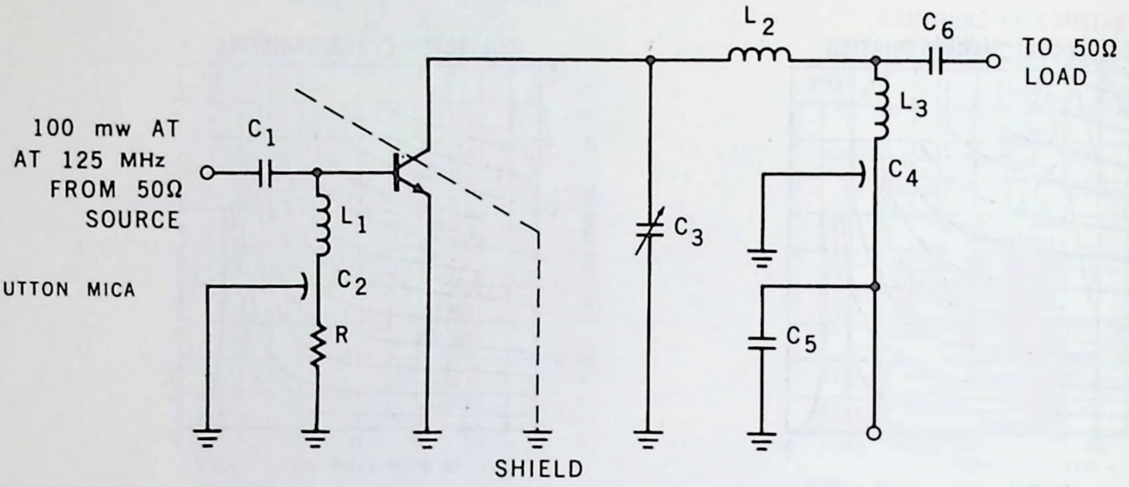
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



125 MHz POWER AMPLIFIER



100 mw AT
AT 125 MHz
FROM 50Ω
SOURCE
C_1
L_1
C_2
R
SHIELD
C_3
L_2
C_6
TO 50Ω
LOAD
L_3
C_4
C_5

$C_1 . C_2 . C_4 . C_6$ = 1000 pF BUTTON MICA

C_3 = 2 - 8 pF

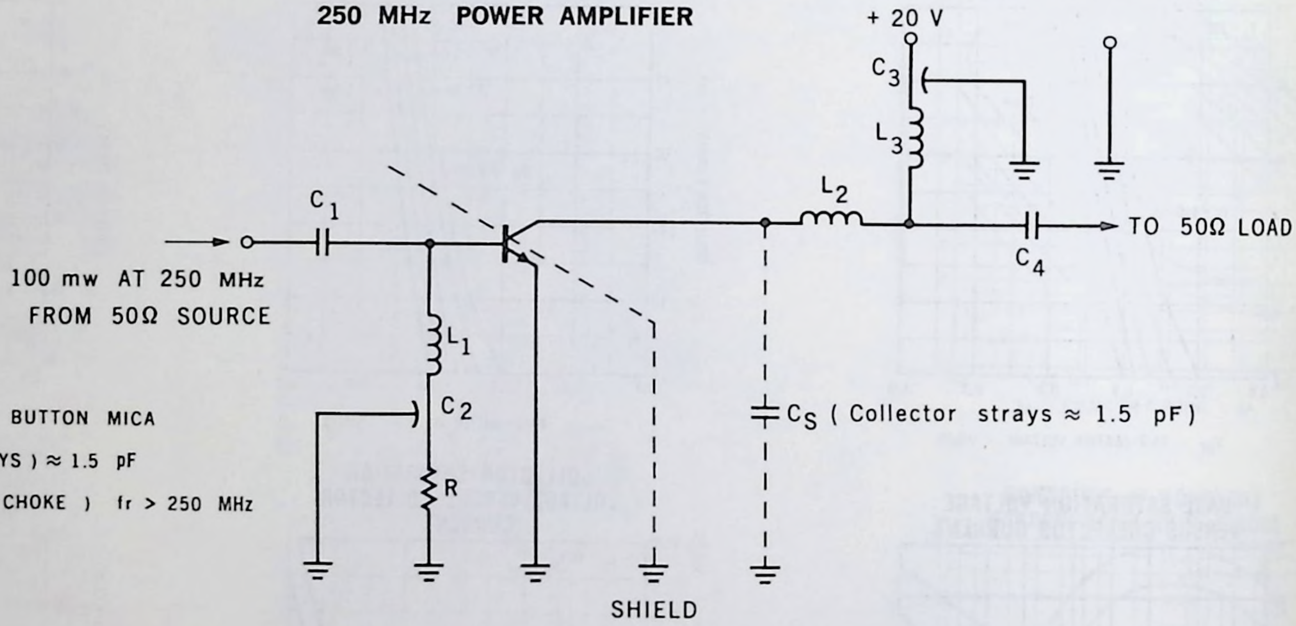
C_5 = 6 μF AT 50 V

L_1 L_3 = RFC. fr > 125 MHz

L_2 = - 16 pF

R = 200 Ω

250 MHz POWER AMPLIFIER



+ 20 V
C_3
L_3
C_1
L_2
TO 50Ω LOAD
C_4
100 mw AT 250 MHz
FROM 50Ω SOURCE
L_1
C_2
R
C_S (Collector strays ≈ 1.5 pF)
SHIELD

C_1 = 120 pF

$C_2 . C_3 . C_4$ = 1000 pF BUTTON MICA

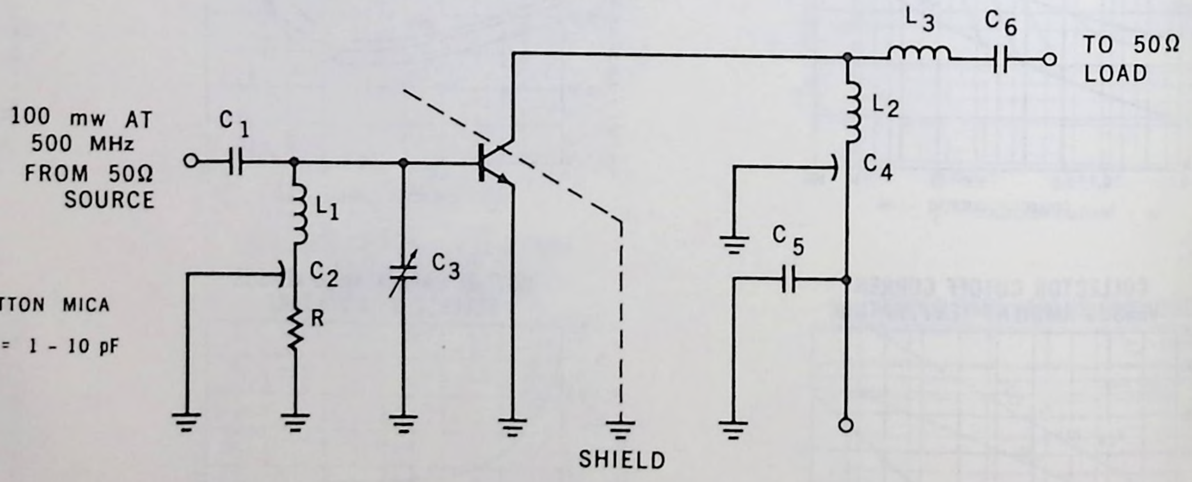
C_S (COLLECTOR STRAYS) ≈ 1.5 pF

$L_1 . L_3$ = .47 μH (RF CHOKE) fr > 250 MHz

L_2 = -5.5 pF

R = 200 Ω

500 MHz POWER AMPLIFIER



100 mw AT
500 MHz
FROM 50Ω
SOURCE
C_1
L_1
C_2
R
C_3
SHIELD
L_3
C_6
TO 50Ω
LOAD
L_2
C_4
C_5

C_1 = 10 pF

$C_2 . C_4 . C_6$ = 1000 pF BUTTON MICA

C_5 = 6 μF AT 50 V C_3 = 1 - 10 pF

L_1 = - 9 pF

L_2 = - 3.5 pF

L_3 = - 7.5 pF

R = 20 Ω

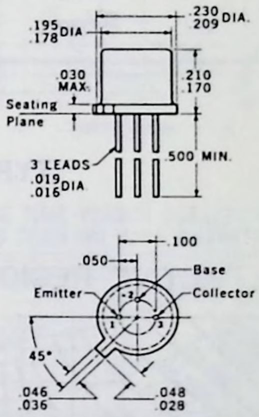
2N3209

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

e 2N3209 is a 550 mc PNP diffused silicon PLANAR epitaxial transistor designed for saturated d non-saturated switching circuits requiring up to 200 milliamperes of collector current. It is table for 20 mc RF amplifiers, 10.7 mc IF amplifiers, 100 mc oscillator converter circuits.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

SOLUTE MAXIMUM RATING [Note 1]

Maximum Temperatures

Storage Temperature	**−65°C** to **+200°C**
Operating Junction Temperature	**200°C** Maximum
Lead Temperature (Soldering, 60 sec time limit)	**300°C** Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	**1.2** Watts
at 25°C Ambient Temperature [Notes 2 and 3]	**0.36** Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	**−20** Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	**−20** Volts
V_{EBO}	Emitter to Base Voltage	**−4.0** Volts
I_C	Collector Current	**200** mA

CTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	**30**	**75**	**120**		$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**25**	**67**			$I_C = 10$ mA	$V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**15**	**30**			$I_C = 100$ mA	$V_{CE} = -1.0$ V
V_{CE} (sat)	Collector Saturation Voltage		**−0.07**	**−0.15**	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.1**	**−0.2**	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.28**	**−0.6**	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	**4.0**	**5.5**			$I_C = 30$ mA	$V_{CE} = -10$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	**−20**			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
t_{on}	Turn On Time [Note 6]		**23**	**60**	nsec	$I_C \approx 30$ mA	$I_{B1} \approx 1.5$ mA
t_{off}	Turn Off Time [Note 6]		**34**	**90**	nsec	$I_C \approx 30$ mA, $I_{B1} \approx$	$I_{B2} \approx 1.5$ mA

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ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C); unction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C.)
This rating refers to a high-current point where collector-to-emitter voltage is lowest.
Pulse Conditions: length = 300 μsec; duty cycle = 1%.
See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

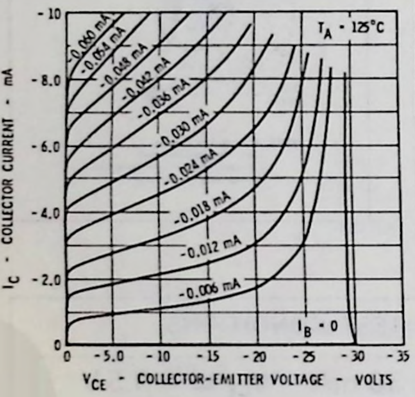
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

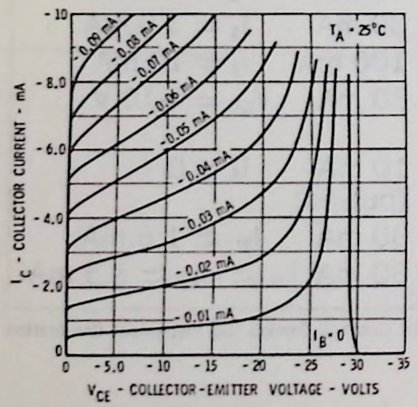
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

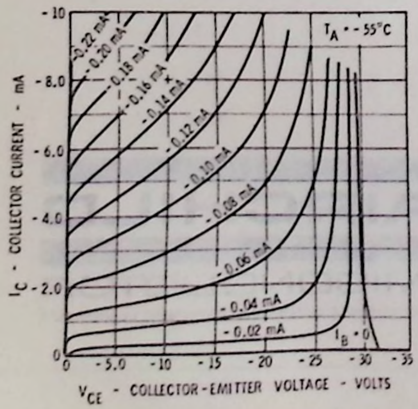
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12	43			I_C = 30 mA	V_{CE} = −0.5 V
V_{BE} (sat)	Base Saturation Voltage	−0.78	−0.92	−0.98	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage	−0.85	−1.1	−1.2	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Base Saturation Voltage		−1.4	−1.7	Volts	I_C = 100 mA	I_B = 10 mA
I_{CES}	Collector Reverse Current		0.05	80	nA	V_{CE} = −10 V	V_{BE} = 0
I_{CES} (125°C)	Collector Reverse Current		0.025	10	μA	V_{CE} = −10 V	V_{BE} = 0
C_{ob}	Output Capacitance		3.0	5.0	pf	V_{CB} = −5.0 V	I_E = 0
C_{TE}	Emitter Transition Capacitance		3.8	6.0	pf	V_{EB} = −0.5 V	I_C = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−20			Volts	I_C = 10 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−20			Volts	I_C = 10 μA	V_{EB} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	I_E = 100 μA	I_C = 0

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

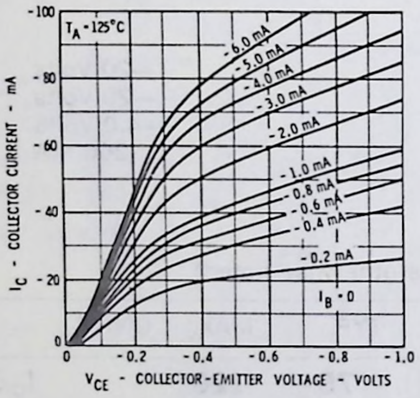
ACTIVE REGION

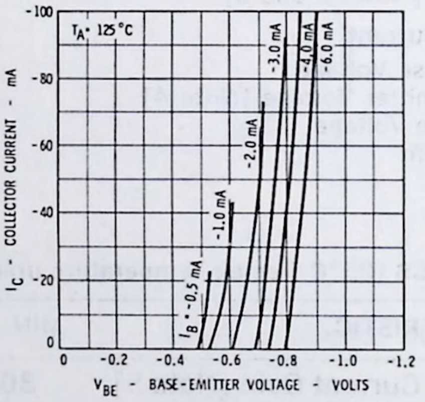


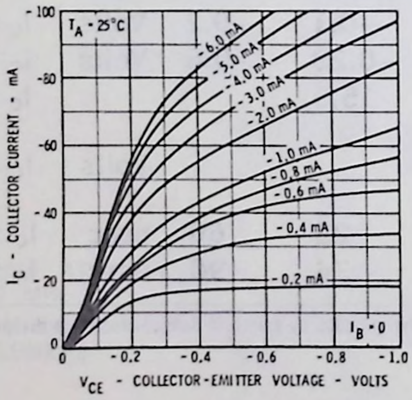


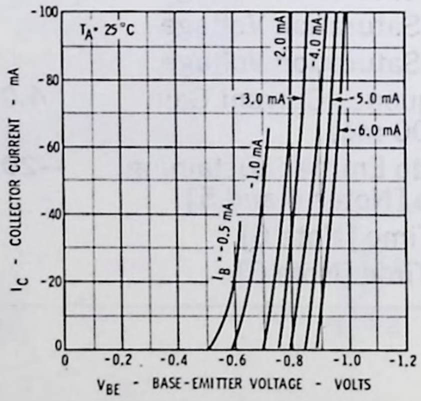


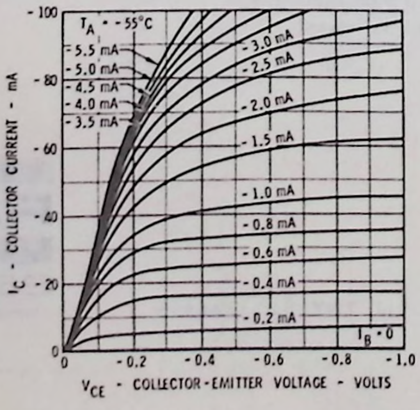
SATURATION REGION

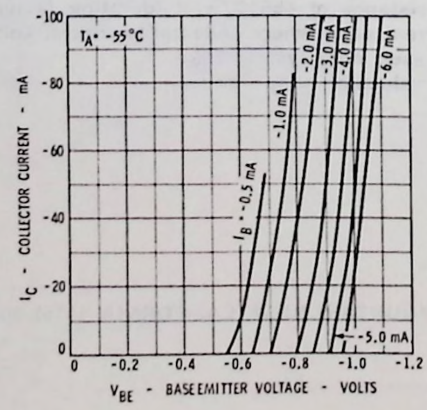




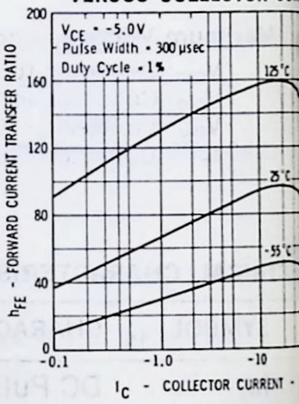




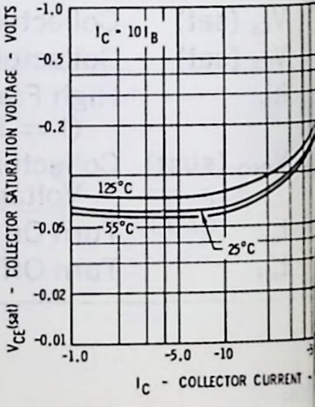




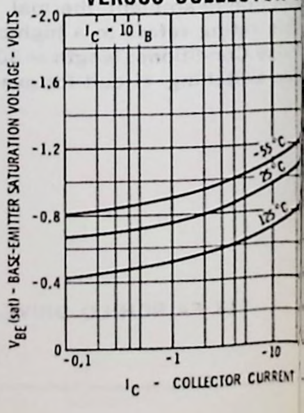
PULSED DC CURRENT G
VERSUS COLLECTOR CUR



COLLECTOR SATURATION V
VERSUS COLLECTOR CU



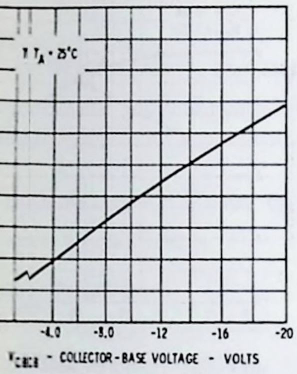
BASE SATURATION VO
VERSUS COLLECTOR C



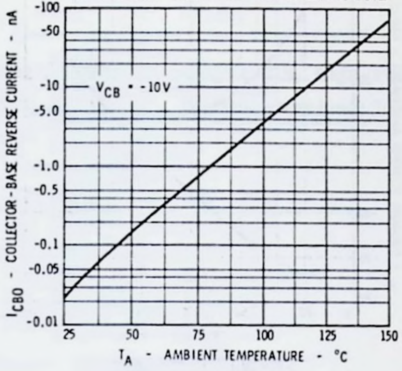
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

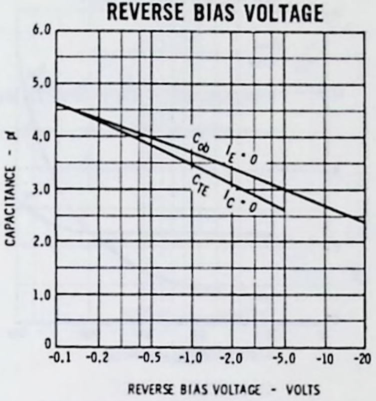
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



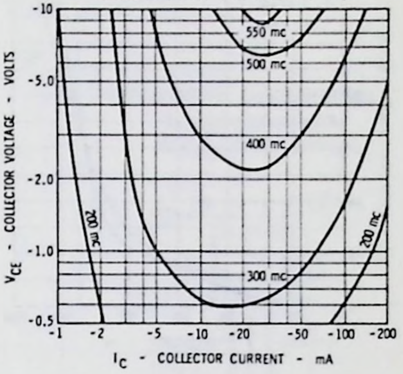
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



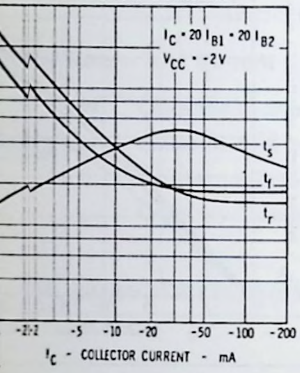
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



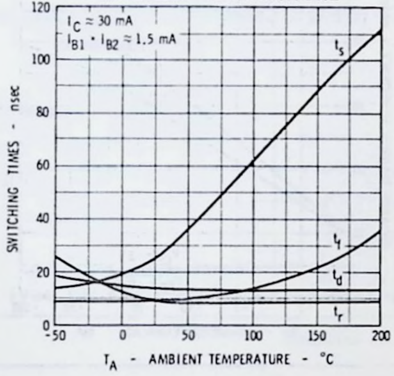
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



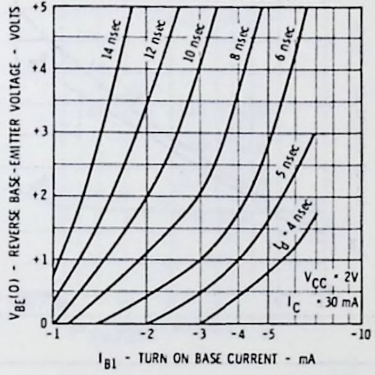
SWITCHING TIMES VERSUS COLLECTOR CURRENT



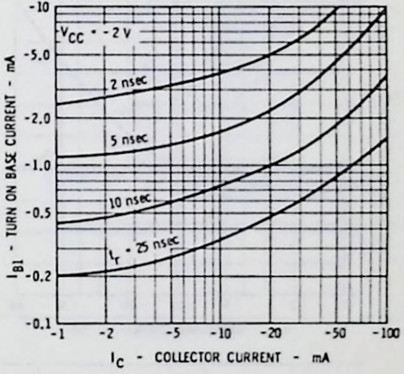
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



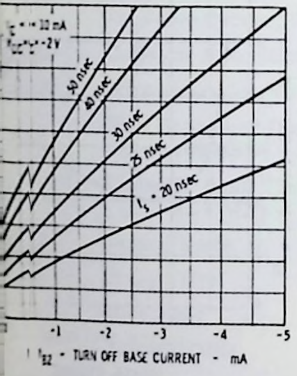
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



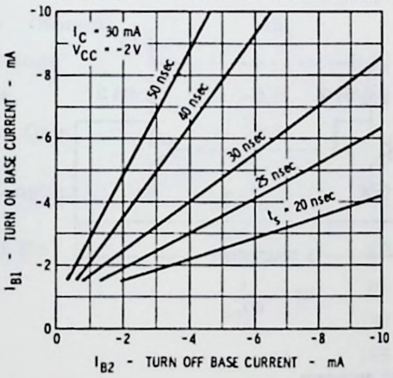
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



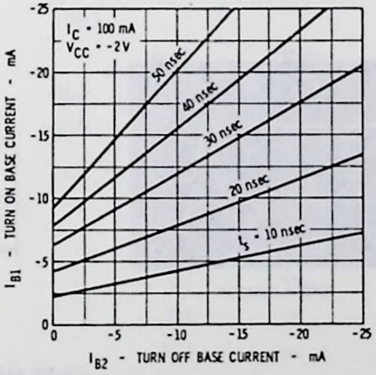
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



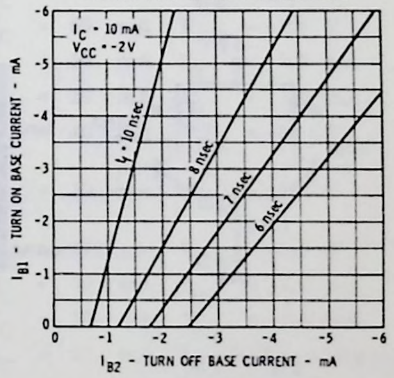
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



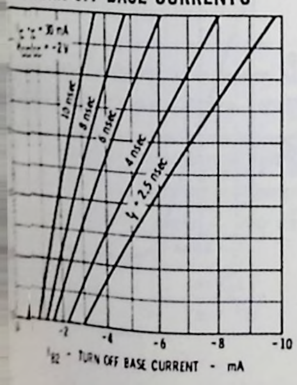
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



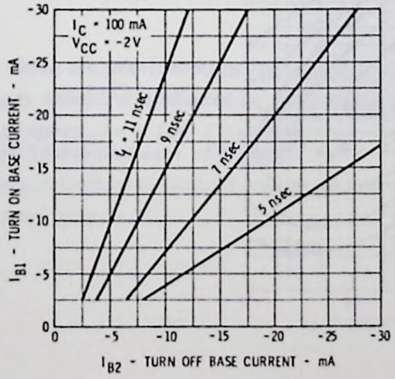
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



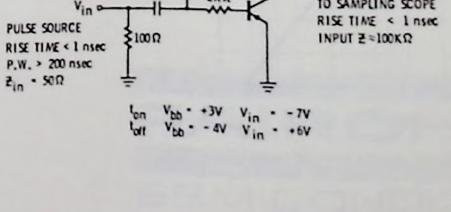
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

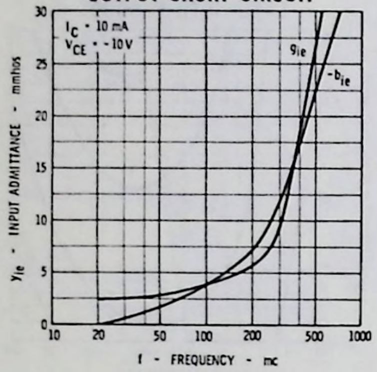


SWITCHING TIME TEST CIRCUIT

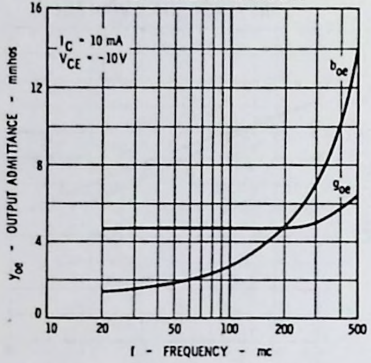

V_bb
-2V
100Ω
62Ω
V_out
0.1
2KΩ
V_in
100Ω
PULSE SOURCE
RISE TIME < 1 nsec
P.W. > 200 nsec
Z_in = 50Ω
TO SAMPLING SCOPE
RISE TIME < 1 nsec
INPUT Z ≈ 100KΩ
t_on V_bb = +3V V_in = -7V
t_off V_bb = -4V V_in = +6V

TYPICAL COMMON EMITTER "Y" PARAMETERS

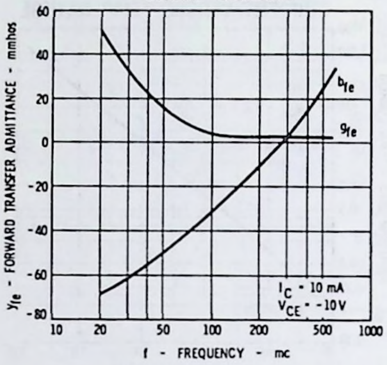
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



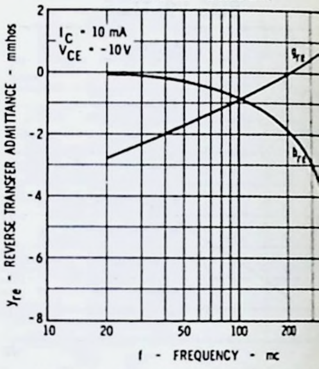
OUTPUT ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



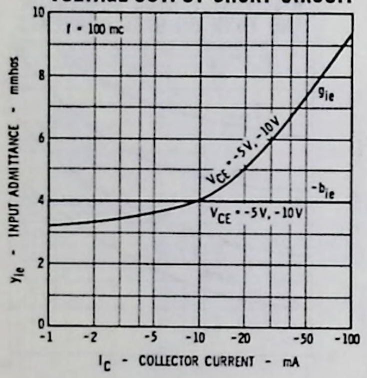
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



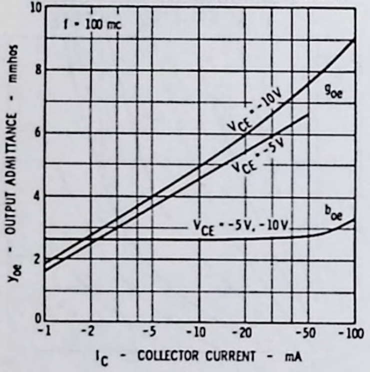
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



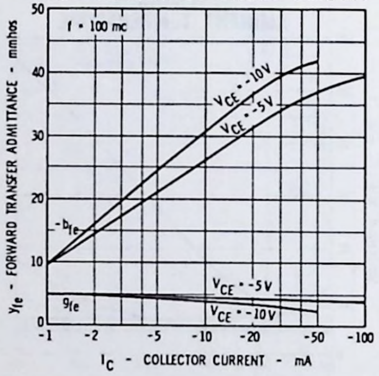
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



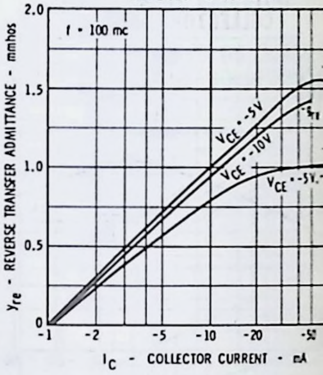
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



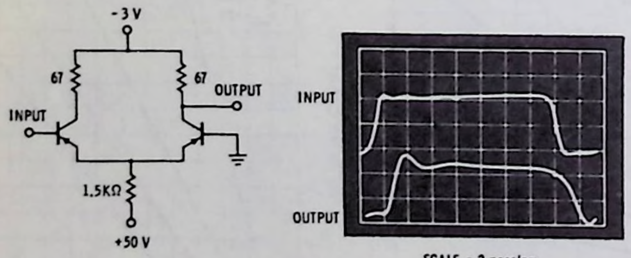
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT

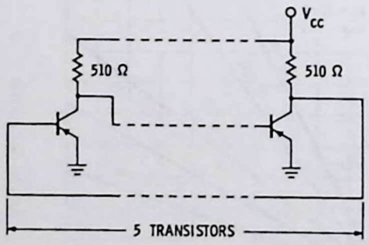


NON SATURATED SWITCHING PERFORMANCE



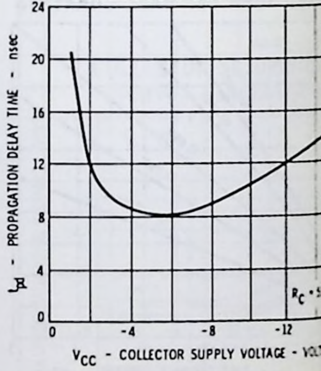
SCALE = 2 nsec/cm

FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

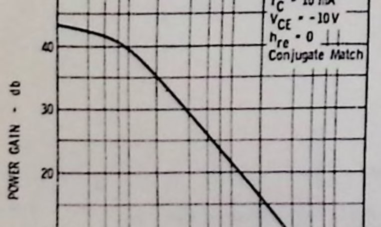


$$t_{pd} = \frac{1}{10\, f_{osc}}$$

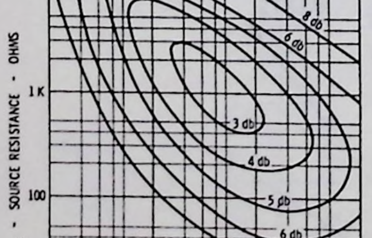
PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



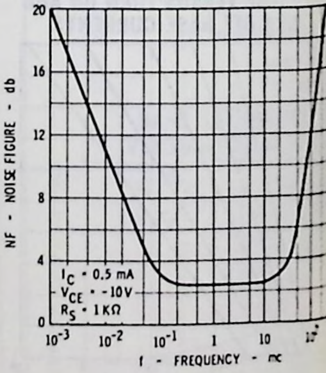
IDEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



NOISE FIGURE VERSUS FREQUENCY



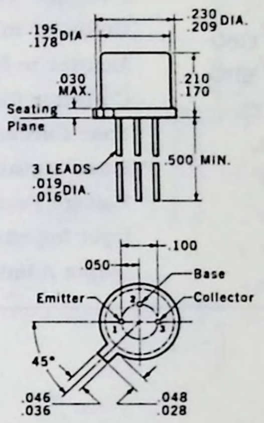
2N3250 · 2N3251

PNP HIGH SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N4034 • 2N4035

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

NERAL DESCRIPTION - The 2N3250 and 2N3251 are High-Gain, High-Voltage Silicon PNP Transistors itable for a wide range of applications including high-voltage switching; low-noise, low-current requirents; and high-gain RF applications.

SOLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 Second Time Limit)	300°C Maximum

aximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.2 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.36 Watt

aximum Voltages and Current

V_{CBO}	Collector to Base Voltage	-50 Volts
V_{CEO}	Collector to Emitter Voltage	-40 Volts
V_{EBO}	Emitter to Base Voltage	-5.0 Volts
I_C	Collector Current	200 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3250		2N3251			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain	40		80			I_C = 100 μA V_{CE} = -1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	50	150	100	300		I_C = 10 mA V_{CE} = -1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	15		30			I_C = 50 mA V_{CE} = -1.0 V
V_{CE}(sat)	Collector Saturation Voltage		-0.25		-0.25	Volt	I_C = 10 mA I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage	-0.6	-0.9	-0.6	-0.9	Volt	I_C = 10 mA I_B = 1.0 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5		3.0			I_C = 10 mA V_{CE} = -20 V
$r_b'C_c$	Collector Base Time Constant (f = 31.8 MHz)		250		250	ps	I_C = 10 mA V_{CE} = -20 V
NF	Noise Figure (f = 100 Hz)		6.0		6.0	dB	I_C = 100 μA V_{CE} = -5.0 V
t_d	Delay Time		35		35	ns	I_C = 10 mA I_{B1} = 1.0 mA
t_r	Rise Time		35		35	ns	I_C = 10 mA I_{B1} = 1.0 mA
t_s	Storage Time		175		200	ns	I_C = 10 mA I_{B1} = I_{B2} = 1.0 mA
t_f	Fall Time		50		50	ns	I_C = 10 mA I_{B1} = I_{B2} = 1.0 mA

*Planar is a patented Fairchild process.

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 145°C/Watt (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/Watt (derating factor of 2.1 mW/°C).

Rating refers to a high current point where collector-to-emitter voltage is lowest.

Pulse conditions: Length = 300 μs ; duty cycle = 1%.

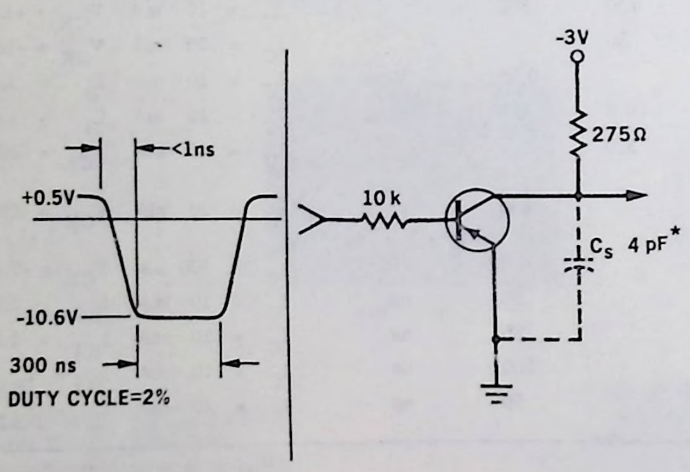
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

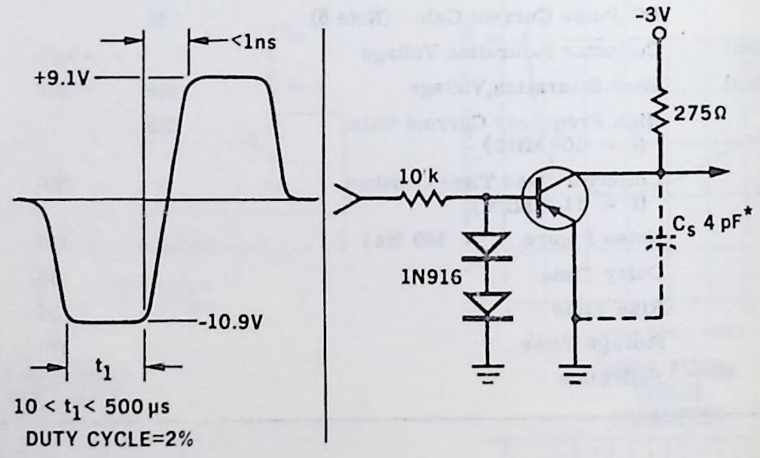
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3250		2N3251				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions	
C_{obo}	Output Capacitance		6.0		6.0	pF	I_E = 0	V_{CB} = -10 V
C_{TE}	Emitter Transition Capacitance		8.0		8.0	pF	I_C = 0	V_{BE} = -1.0 V
h_{FE}	DC Pulse Current Gain	45		90			I_C = 1.0 mA	V_{CE} = -1.0 V
$V_{CE}(sat)$	Collector Saturation Voltage		-0.5		-0.5	Volt	I_C = 50 mA	I_B = 5.0 mA
$V_{BE}(sat)$	Base Saturation Voltage		-1.2		-1.2	Volts	I_C = 50 mA	I_B = 5.0 mA
BV_{CEO}	Collector-to-Emitter Breakdown Voltage (Notes 4 and 5)	-40		-40		Volts	I_C = 10 mA	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-50		-50		Volts	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		Volts	I_C = 0	I_E = 10 µA
I_{CEX}	Collector Current		20		20	nA	V_{CE} = -40 V	V_{BE} = 3.0 V
I_{BL}	Base Current		50		50	nA	V_{CE} = -40 V	V_{BE} = 3.0 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	50	200	100	400		I_C = 1.0 mA	V_{CE} = -10 V
h_{re}	Voltage Feedback Ratio (f = 1 kHz)		10		20	$x10^{-4}$	I_C = 1.0 mA	V_{CE} = -10 V
h_{ie}	Input Impedance (f = 1 kHz)	1.0	6.0	2.0	12	kΩ	I_C = 1.0 mA	V_{CE} = -10 V
h_{oe}	Output Admittance (f = 1 kHz)	4.0	40	10	60	µmho	I_C = 1.0 mA	V_{CE} = -10 V

FIG. 1 DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT • **FIG. 2 STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT**





*TOTAL SHUNT CAPACITANCE OF TEST JIG AND CONNECTORS

2N3250A • 2N3251A

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The 2N3250A and 2N3251A are PNP silicon Planar epitaxial transistors designed primarily for fast high voltage switching and high-gain RF applications.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 Second Time Limit)	300°C Maximum

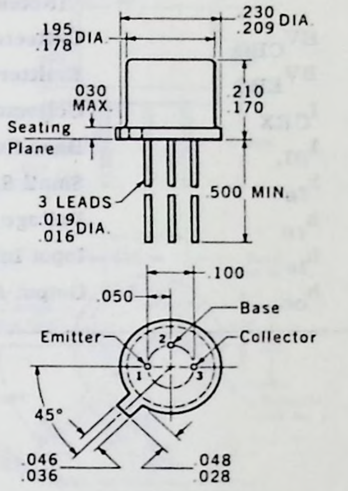
Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.2 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	-60 Volts
V_{CEO}	Collector to Emitter Voltage	-60 Volts
V_{EBO}	Emitter to Base Voltage	-5.0 Volts
I_C	Collector Current	200 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3250A Min.	2N3250A Max.	2N3251A Min.	2N3251A Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain	40		80			I_C = 100 μA V_{CE} = -1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	50	150	100	300		I_C = 10 mA V_{CE} = -1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	15		30			I_C = 50 mA V_{CE} = -1.0 V
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 5)		-0.25		-0.25	Volt	I_C = 10 mA I_B = 1.0 mA
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 5)	-0.6	-0.9	-0.6	-0.9	Volt	I_C = 10 mA I_B = 1.0 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5		3.0			I_C = 10 mA V_{CE} = -20 V
$r_b'C_c$	Collector Base Time Constant (f = 31.8 MHz)		250		250	ps	I_C = 10 mA V_{CE} = -20 V
NF	Noise Figure (f = 100 Hz)		6.0		6.0	dB	I_C = 100 μA V_{CE} = -5.0 V
t_d	Delay Time		35		35	ns	I_C = 10 mA I_{B1} = 1.0 mA
t_r	Rise Time		35		35	ns	I_C = 10 mA I_{B1} = 1.0 mA
t_s	Storage Time		175		200	ns	I_C = 10 mA I_{B1} = I_{B2} = 1.0 mA
t_f	Fall Time		50		50	ns	I_C = 10 mA I_{B1} = I_{B2} = 1.0 mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 145°C/Watt (derating factor of 6.9 mW/°C); junction to ambient thermal resistance of 486°C/Watt (derating factor of 2.1 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: Length = 300 μsec; duty cycle = 1%.

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3250A Min.	2N3250A Max.	2N3251A Min.	2N3251A Max.	Units	Test Conditions	
C_{obo}	Output Capacitance		6.0		6.0	pF	I_E = 0	V_{CB} = -10 V
C_{ibo}	Input Capacitance		8.0		8.0	pF	I_C = 0	V_{BE} = -1.0 V
h_{FE}	DC Pulse Current Gain	45		90			I_C = 1.0 mA	V_{CE} = -1.0 V
V_{CE}(sat)	Pulsed Collector Saturation Voltage		-0.5		-0.5	Volt	I_C = 50 mA	I_B = 5.0 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage		-1.2		-1.2	Volts	I_C = 50 mA	I_B = 5.0 mA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-60		-60		Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-60		Volts	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		Volts	I_C = 0	I_E = 10 μA
I_{CEX}	Collector Current		20		20	nA	V_{CE} = -40 V	V_{BE} = +3.0 V
I_{BL}	Base Current		50		50	nA	V_{CE} = -40 V	V_{BE} = +3.0 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	50	200	100	400		I_C = 1.0 mA	V_{CE} = -10 V
h_{re}	Voltage Feedback Ratio (f = 1 kHz)		10		20	$\times 10^{-4}$	I_C = 1.0 mA	V_{CE} = -10 V
h_{ie}	Input Impedance (f = 1 kHz)	1.0	6.0	2.0	12	kΩ	I_C = 1.0 mA	V_{CE} = -10 V
h_{oe}	Output Admittance (f = 1 kHz)	4.0	40	10	60	μmho	I_C = 1.0 mA	V_{CE} = -10 V

FIG. 1 DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

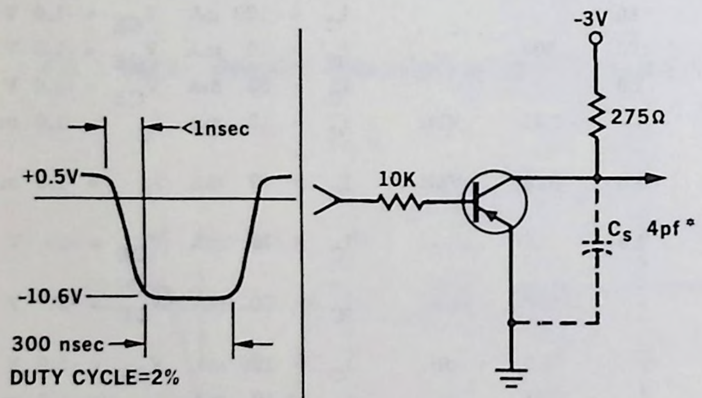
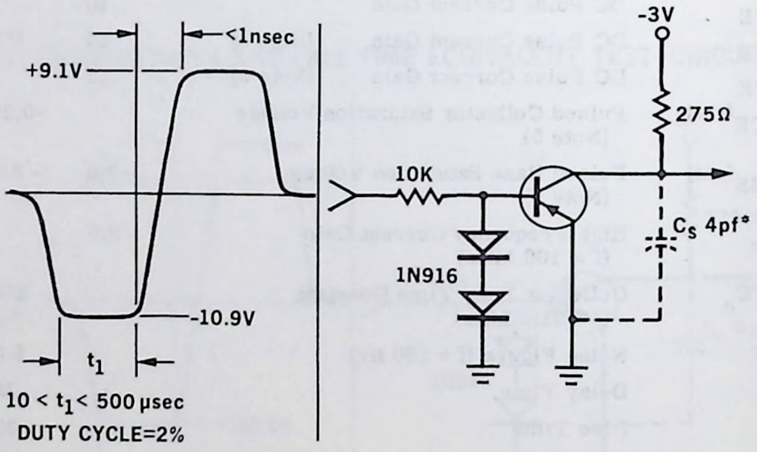


FIG. 2 STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT



*TOTAL SHUNT CAPACITANCE OF TEST JIG AND CONNECTORS

2N3252 · 2N3253 · 2N3444

NPN SWITCHING TYPE

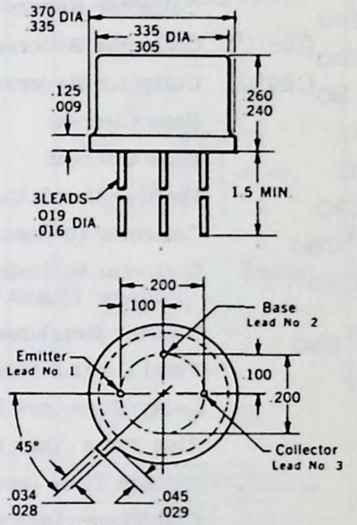
DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3724 · 2N3725

GENERAL DESCRIPTION - The 2N3252, 2N3253, and 2N3444 are Double Diffused Silicon NPN Transistors packaged in the JEDEC TO-5 outline. They are designed for high-speed switching, high-frequency amplifier applications, and may be used as core drivers, relay drivers, and pulse generators.

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-5) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature		-65°C to +200°C
Operating Junction Temperature		+200°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	2N3252 · 2N3253	+300°C Maximum
Lead Temperature (Soldering, 10 sec Time Limit)	2N3444	+240°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	5.0 Watts
at 25°C Ambient Temperature	1.0 Watt

Maximum Voltages and Currents		2N3252	2N3253	2N3444
V_{CBO}	Collector to Base Voltage	60 Volts	75 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage	30 Volts	40 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts	5.0 Volts
I_C	Collector Current	1.0 Amp	1.0 Amp	1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3252		2N3253		2N3444			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	30		25		20			I_C = 150 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	90			20	60		I_C = 500 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)			25	75				I_C = 375 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	25				15			I_C = 1.0 A V_{CE} = 5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)			20					I_C = 750 mA V_{CE} = 5.0 V
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 5)		1.0		1.0		1.0	Volts	I_C = 150 mA I_B = 15 mA
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 5)	0.7	1.3	0.7	1.3	0.7	1.3	Volts	I_C = 500 mA I_B = 50 mA
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 5)		1.8		1.8		1.8	Volts	I_C = 1.0 A I_B = 100 mA
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 5)		0.3		0.35		0.35	Volts	I_C = 150 mA I_B = 15 mA
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 5)		0.5		0.6		0.6	Volts	I_C = 500 mA I_B = 50 mA
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 5)		1.0		1.2		1.2	Volts	I_C = 1.0 A I_B = 100 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0		1.75		1.5			I_C = 50 mA V_{CE} = 10 V
C_{ibo}	Input Capacitance		80		80		80	pf	I_C = 0 V_{EB} = 0.5 V
C_{obo}	Output Capacitance		12				12	pf	I_E = 0 V_{CB} = 10 V
C_{obo}	Output Capacitance				12			pf	I_E = 0 V_{CB} = 20 V

FAIRCHILD

SEMICONDUCTOR

A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3252		2N3253		2N3444			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions
I_{CEX}	Collector Reverse Current				500		500	nA	$V_{CE} = 60$ V $V_{EB} = 4.0$ V
I_{CEX}	Collector Reverse Current		500					nA	$V_{CE} = 40$ V $V_{EB} = 4.0$ V
I_{CBO}	Collector Reverse Current				500		500	nA	$I_E = 0$ $V_{CB} = 60$ V
I_{CBO}	Collector Reverse Current		500					nA	$I_E = 0$ $V_{CB} = 40$ V
I_{CBO}(100°C)	Collector Reverse Current				75		75	μA	$I_E = 0$ $V_{CB} = 60$ V
I_{CBO}(100°C)	Collector Reverse Current		75					μA	$I_E = 0$ $V_{CB} = 40$ V
I_{BL}	Base Current				500		500	nA	$V_{CE} = 60$ V $V_{OB} = 4.0$ V
I_{BL}	Base Current		500					nA	$V_{CE} = 40$ V $V_{OB} = 4.0$ V
I_{EBO}	Emitter Cutoff Current		50		50		50	nA	$I_C = 0$ $V_{EB} = 4.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	60		75		80		Volts	$I_C = 10$ μA $I_E = 0$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30		40		50		Volts	$I_C = 10$ mA $I_B = 0$
BV_{EBO}	Emitter Breakdown Voltage	5.0		5.0		5.0		Volts	$I_C = 0$ $I_E = 10$ μA
Q_T	Total Control Charge (see Fig. 3)		5.0		5.0		5.0	ncoul	$I_C = 500$ mA $I_B = 50$ mA
t_d	Delay Time (see Fig. 1)		15		15		15	nsec	$I_C = 500$ mA $I_{B1} = 50$ mA
t_r	Rise Time (see Fig. 1)		30		35		35	nsec	$I_C = 500$ mA $I_{B1} = 50$ mA
t_s	Storage Time (see Fig. 2)		40		40		40	nsec	$I_C = 500$ mA $I_{B1} = I_{B2} = 50$ mA
t_f	Fall Time (see Fig. 2)		30		30		30	nsec	$I_C = 500$ mA $I_{B1} = I_{B2} = 50$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/Watt (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 175°C/Watt (derating factor of 5.7 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: Length = 300 μsec; duty cycle ≤1%.

FIGURE 1 - EQUIVALENT CIRCUIT FOR MEASURING DELAY AND RISE TIMES

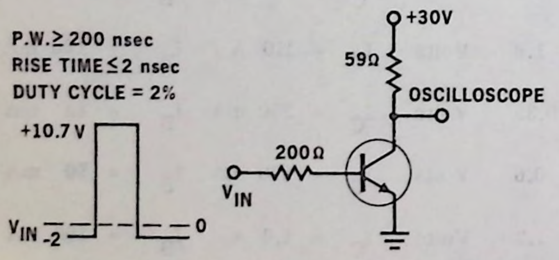

P.W.≥ 200 nsec
RISE TIME≤2 nsec
DUTY CYCLE = 2%
+10.7 V
V_{IN} -2
0
+30V
59Ω
OSCILLOSCOPE
200Ω
V_{IN}

FIGURE 2 - EQUIVALENT CIRCUIT FOR MEASURING STORAGE AND FALL TIMES

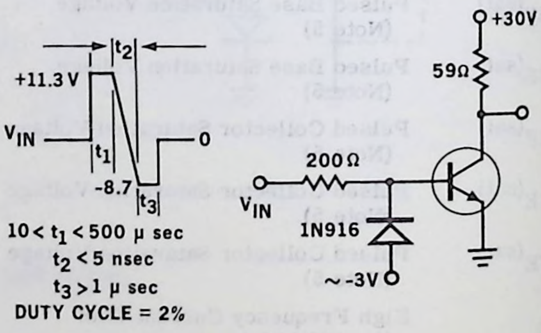
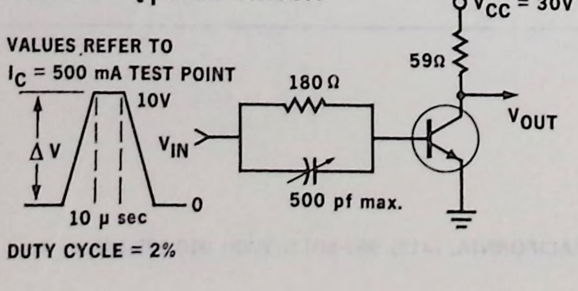

t_2
+11.3 V
V_{IN}
t_1
0
-8.7
t_3
10 < t_1 < 500 μ sec
t_2 < 5 nsec
t_3 > 1 μ sec
DUTY CYCLE = 2%
+30V
59Ω
200Ω
V_{IN}
1N916
~-3V

FIGURE 3 - Q_T TEST CIRCUIT


VALUES REFER TO
I_C = 500 mA TEST POINT
10V
ΔV
10 μ sec
0
DUTY CYCLE = 2%
V_{IN}
180 Ω
500 pf max.
59Ω
V_{CC} = 30V
V_{OUT}

2N3299 · 2N3300 · 2N3301 · 2N3302

NPN RF AMPLIFIERS AND HIGH-SPEED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

ENERAL DESCRIPTION - The 2N3299 through 2N3302 are NPN Silicon Planar Epitaxial ransistors designed to cover a wide range of RF amplifier and high-speed switching pplications. These devices feature a minimum LV_{CEO} of 30 volts, a minimum f_T of 50 MHz at I_C = 50 mA, V_{CE} = 10 volts, together with a maximum V_{CE}(sat) of 0.6 volt at 00 mA and h_{FE} specified from 100 μA to 500 mA collector current.

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, No Time Limit)	300°C Maximum

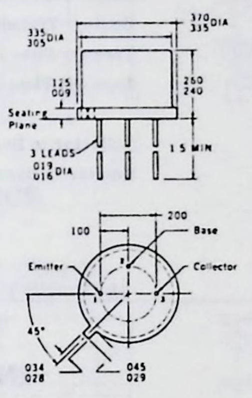
Maximum Power Dissipation (Notes 2 and 3)	2N3299 2N3300	2N3301 2N3302
Total Dissipation at 25°C Case Temperature	3.0 Watts	1.8 Watts
at 25°C Ambient Temperature	0.8 Watt	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-5) outline

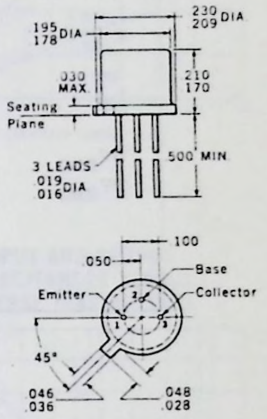


NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N3299 · 2N3300

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

2N3301 · 2N3302

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3299 2N3301 Min.	Typ.	Max.	2N3300 2N3302 Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	40	75	120	100	220	300		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	20	40		35	80			I_C = 100 μA V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage		0.4	0.6		0.4	0.6	Volts	I_C = 500 mA I_B = 50 mA
V_{BE}(sat)	Base Saturation Voltage		1.1	1.5		1.1	1.5	Volts	I_C = 500 mA I_B = 50 mA
V_{CEO}(sust)	Collector to Emitter Sustaining voltage (Notes 4 and 5)	30			30			Volts	I_C = 10 mA I_B = 0 (pulsed)
I_{CES}	Collector Reverse Current		0.2	10		0.2	10	nA	V_{CE} = 50 V V_{EB} = 0
h_{FE}	DC Pulse Current Gain (Note 5)	35	70		75	205			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	25	58		50	140			I_C = 1.0 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	62		50	125			I_C = 500 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	50		50	75			I_C = 150 mA V_{CE} = 1.0 V

*Planar is a patented Fairchild process.

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance for the 2N3299 and 2N3300 of 58.3°C/Watt (derating factor of 17.2 mW/°C); for the 2N3301 and 2N3302 97.3°C/Watt (derating factor of 10.3 mW/°C). Junction-to-ambient thermal resistance for the 2N3299 and 2N3300 of 219°C/Watt (derating factor of 4.56 mW/°C); for the 2N3301 and 2N3302 486°C/Watt (derating factor of 2.06 mW/°C).

This rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μs ; duty cycle ≤ 2%.

See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

FAIRCHILD SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

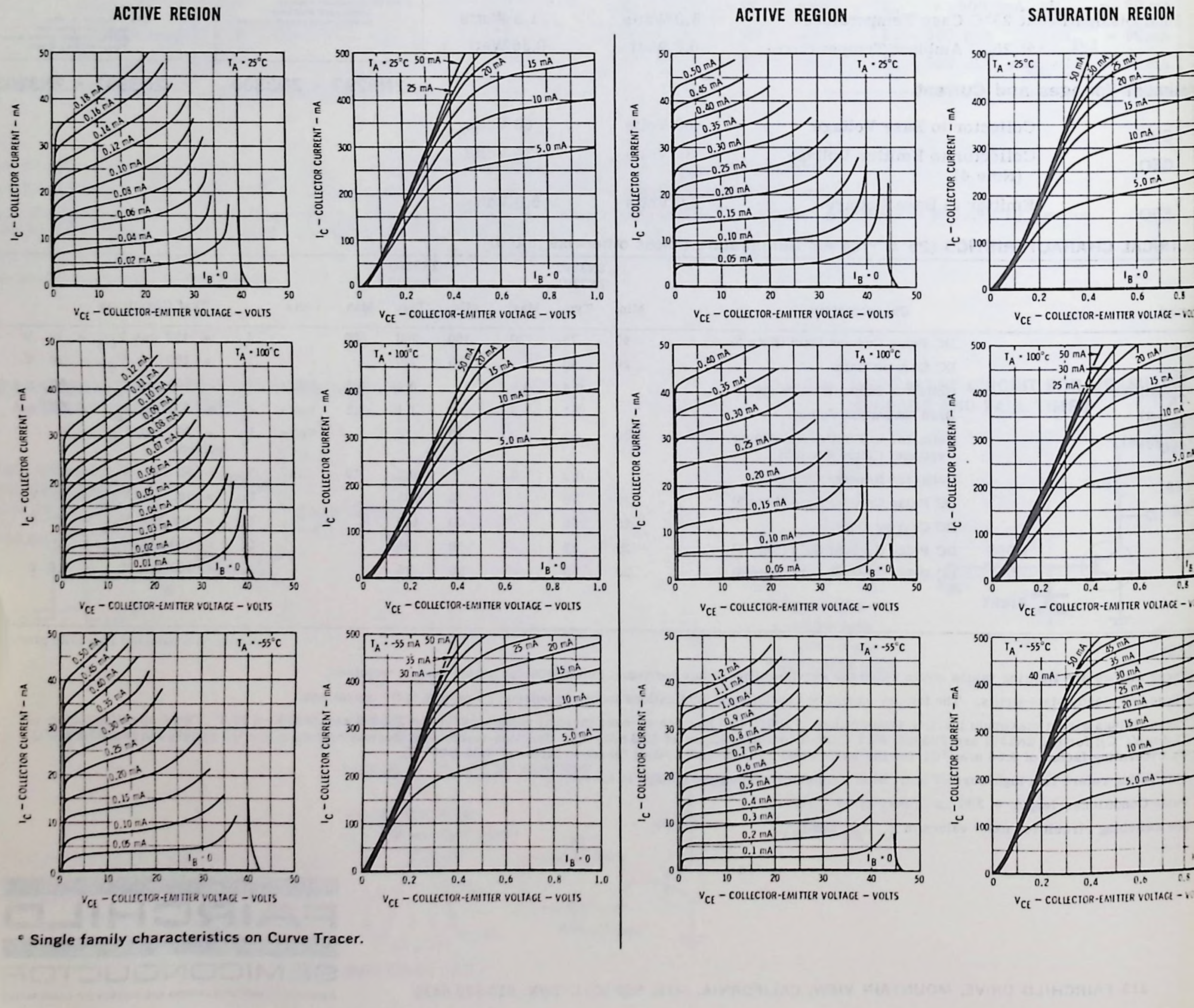
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic	2N3299 2N3301 Min.	Typ.	Max.	2N3300 2N3302 Min.	Typ.	Max.	Units	Test Conditions
V_{CE}(sat)	Collector Saturation Voltage		0.14	0.22		0.14	0.22	Volts	I_C = 150 mA I_B = 15
V_{BE}(sat)	Base Saturation Voltage		0.9	1.1		0.9	1.1	Volts	I_C = 150 mA I_B = 15
I_{CES}(150°C)	Collector Reverse Current		0.2	10		0.2	10	μA	V_{CE} = 50 V V_{EB} = 0
I_{EBO}	Emitter Cutoff Current		0.1	10		0.1	10	nA	I_C = 0 V_{EB} = 3.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5	4.0		2.5	4.0			I_C = 50 mA V_{CE} = 10 V
C_{obo}	Output Capacitance		6.0	8.0		6.0	8.0	pF	I_E = 0 V_{CB} = 10 V
C_{ibo}	Emitter Transition Capacitance		14	20		14	20	pF	I_C = 0 V_{EB} = 2.0 V
t_{on}	Turn On Time (Note 6)		14	60		14	60	ns	I_C ≈ 300 mA I_{B1} ≈ 30
t_{off}	Turn Off Time (Note 6)		80	150		80	150	ns	I_C ≈ 300 mA, I_{B1} ≈ 30 I_{B2} ≈ -30 mA
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			Volts	I_C = 10 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	I_E = 10 μA I_C = 0

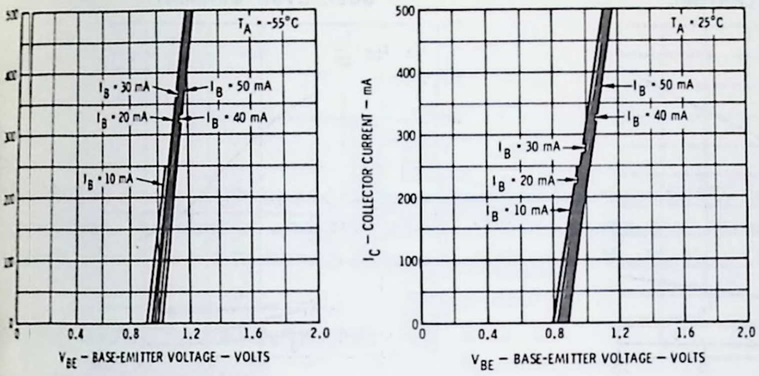
TYPICAL COLLECTOR CHARACTERISTICS *

2N3300 • 2N3302 2N3299 • 2N3301

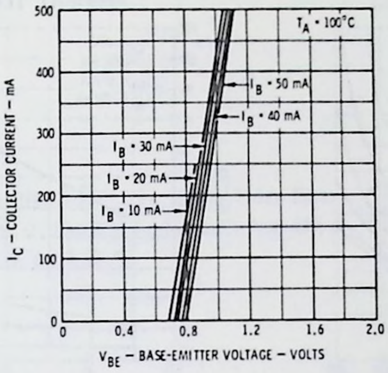


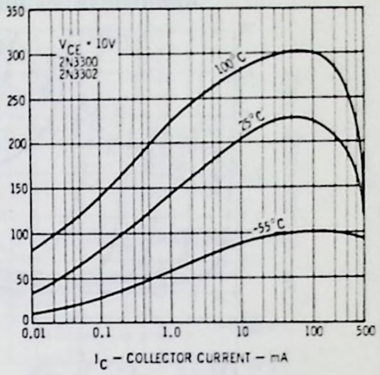
* Single family characteristics on Curve Tracer.

TYPICAL BASE CHARACTERISTICS



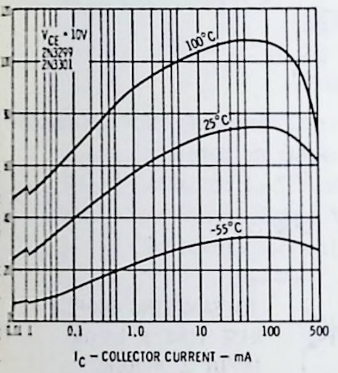
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



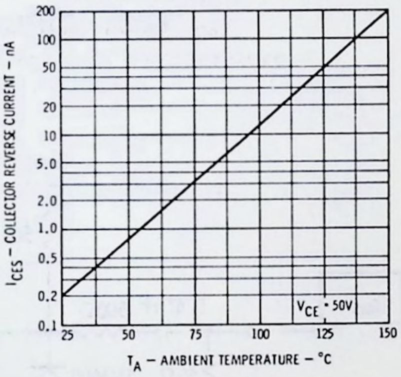


TYPICAL ELECTRICAL CHARACTERISTICS

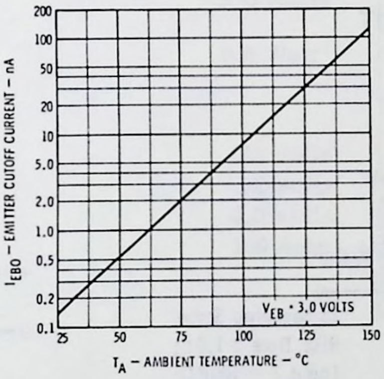
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



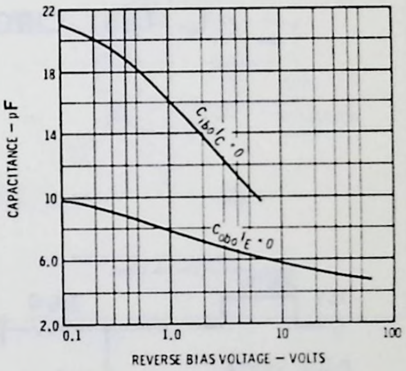
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



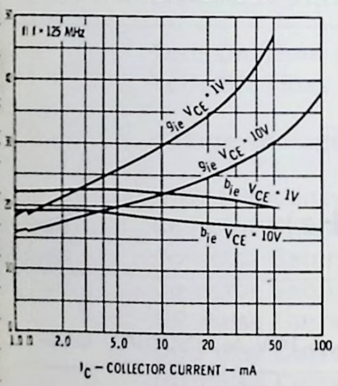
EMITTER CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



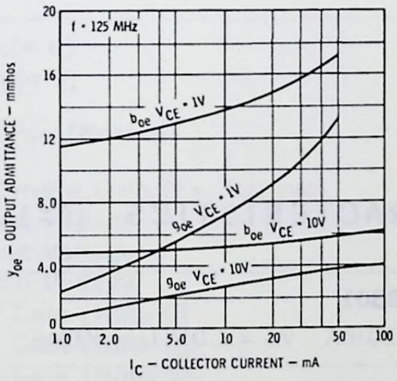
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



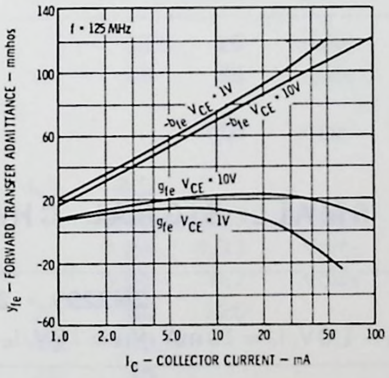
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



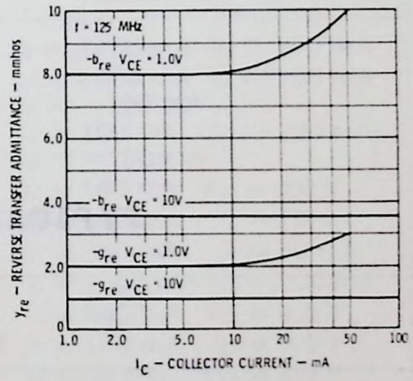
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT— INPUT SHORT CIRCUIT



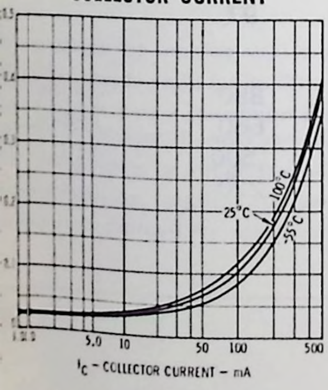
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT— OUTPUT SHORT CIRCUIT



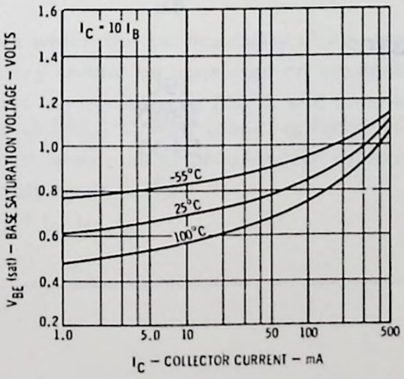
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT— INPUT SHORT CIRCUIT



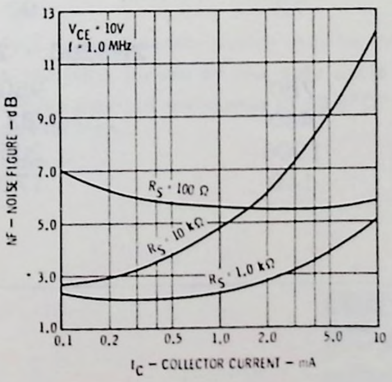
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



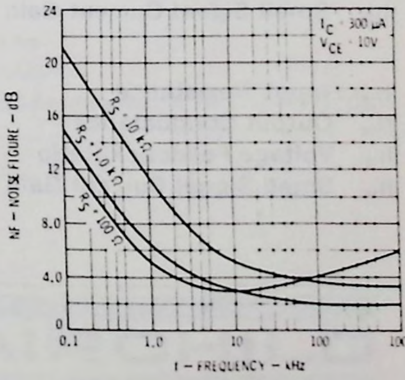
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

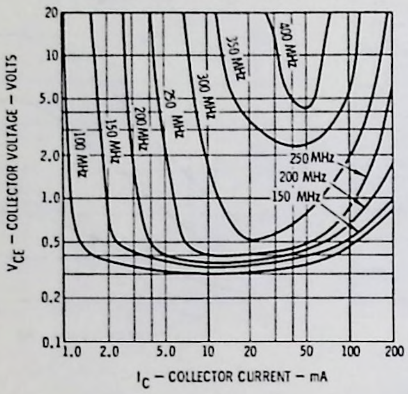


NOISE FIGURE VERSUS COLLECTOR CURRENT

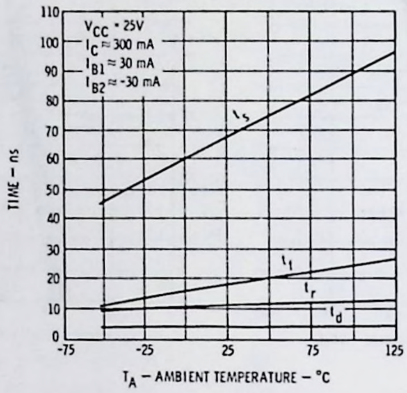


NOISE FIGURE VERSUS FREQUENCY

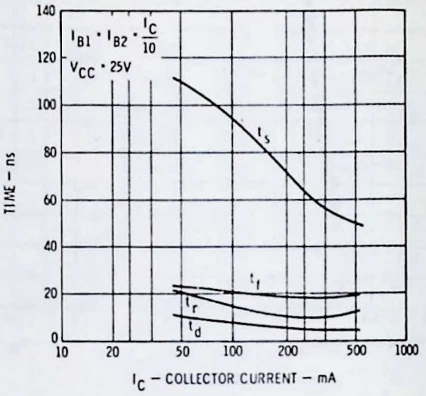




CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

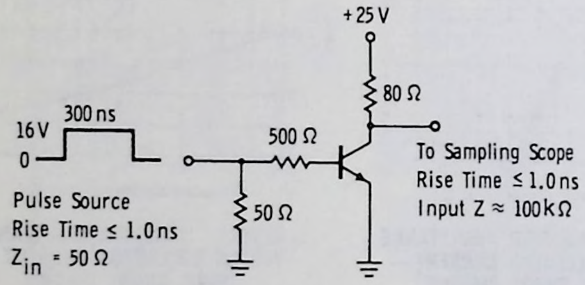


SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



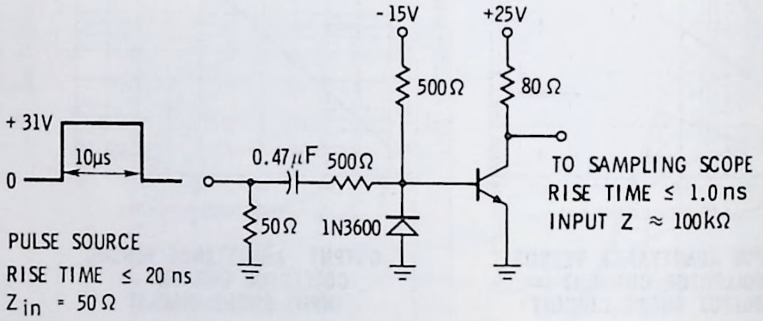
SWITCHING TIMES VERSUS COLLECTOR CURRENT

t_{on} TEST CIRCUIT



+25V
80 Ω
300 ns
16V
0
500 Ω
50 Ω
To Sampling Scope
Rise Time ≤ 1.0 ns
Input Z ≈ 100 kΩ
Pulse Source
Rise Time ≤ 1.0 ns
Z_{in} = 50 Ω

t_{off} TEST CIRCUIT



-15V
+25V
500 Ω
80 Ω
+ 31V
10µs
0
0.47µF
500 Ω
50 Ω
1N3600
TO SAMPLING SCOPE
RISE TIME ≤ 1.0 ns
INPUT Z ≈ 100 kΩ
PULSE SOURCE
RISE TIME ≤ 20 ns
Z_{in} = 50 Ω

TYPICAL SMALL SIGNAL CHARACTERISTICS (f=1 kHz)

		V_{CE} = 1.0V, I_C = 10 mA	V_{CE} = 10V, I_C = 10 mA	V_{CE} = 1.0V, I_C = 50 mA	V_{CE} = 10V, I_C = 50 mA	Units
	2N3299 • 2N3301					
h_{ie}	Input Resistance	380	460	170	350	Ohms
h_{oe}	Output Conductance	410	55	950	405	µmhos
h_{re}	Voltage Feedback Ratio	2250	130	2650	500	$\times 10^{-6}$
h_{fe}	Small Signal Current Gain	72	90	48	97	
	2N3300 • 2N3302					
h_{ie}	Input Resistance	780	950	190	880	Ohms
h_{oe}	Output Conductance	440	83	1300	660	µmhos
h_{re}	Voltage Feedback Ratio	1900	205	5400	1500	$\times 10^{-6}$
h_{fe}	Small Signal Current Gain	140	170	53	220	

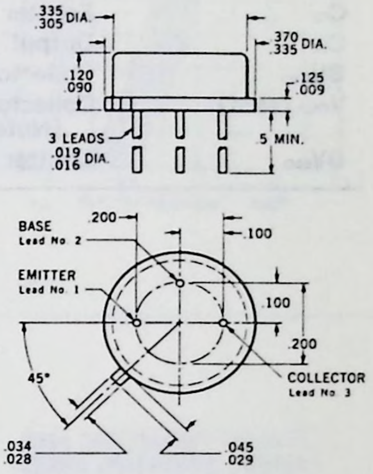
2N3303

NPN HIGH-SPEED, HIGH-CURRENT, SWITCH

SILICON PLANAR EPITAXIAL TRANSISTOR

2N3303 is a very high speed high current switch specifically designed for use as a thin film mory driver. The special characteristics of this device that make it uniquely optimum for this lication are a 450 mc minimum f_T and a maximum V_{CE} (sat) of 0.7 V at 1.0 A.

PHYSICAL DIMENSIONS



NOTES. All dimensions in inches
Lead 3 internally connected to case

SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	**−65°C to +200°C**
Operating Junction Temperature	**200°C** Maximum
Lead Temperature (Soldering, 60 sec. time limit)	**300°C** Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	**3.0** Watts
at 25°C Ambient Temperature [Notes 2 and 3]	**0.6** Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	**25** Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	**12** Volts
V_{EBO}	Emitter to Base Voltage	**4.0** Volts
I_C	Collector Current	**1.0** Amp

CTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
	Turn On Time [Note 6]		**10**	**15**	nsec	$I_C \approx 1000$ mA $I_{B1} \approx 100$ mA
	Turn Off Time [Note 6]		**15**	**25**	nsec	$I_C \approx 1000$ mA $I_{B1} \approx 100$ mA $I_{B2} \approx -100$ mA
	Charge Storage Time [Note 6]			**15**	nsec	$I_C \approx 100$ mA $I_{B1} \approx 100$ mA $I_{B2} \approx -100$ mA
	High Frequency Current Gain (f = 100 mc)	**4.5**	**6.5**			$I_C = 100$ mA $V_{CE} = 5.0$ V
$_{CE}$ (sat)	Collector Saturation Voltage		**0.18**	**0.23**	Volts	$I_C = 100$ mA $I_B = 10$ mA
$_{CE}$ (sat)	Collector Saturation Voltage		**0.24**	**0.33**	Volts	$I_C = 300$ mA $I_B = 30$ mA
$_{CE}$ (sat)	Collector Saturation Voltage		**0.51**	**0.7**	Volts	$I_C = 1000$ mA $I_B = 100$ mA
$_{FE}$	DC Pulse Current Gain [Note 5]	**30**	**60**	**120**		$I_C = 300$ mA $V_{CE} = 0.5$ V
$_{FE}$	DC Pulse Current Gain [Note 5]	**30**	**50**			$I_C = 100$ mA $V_{CE} = 0.5$ V
$_{FE}$	DC Pulse Current Gain [Note 5]	**20**	**45**			$I_C = 10$ mA $V_{CE} = 0.5$ V

S:

hese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
hese are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
hese ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/watt (derating factor of 17.2 mW/°C); nction-to-ambient thermal resistance of 291.6°C/watt (derating factor of 3.43 mW/°C).
is rating refers to a high-current point where collector-to-emitter voltage is lowest.
lse Conditions: length = 300 μsec; duty cycle = 1%.
e switching circuit for exact values of I_C, I_{B1}, I_{B2}.

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

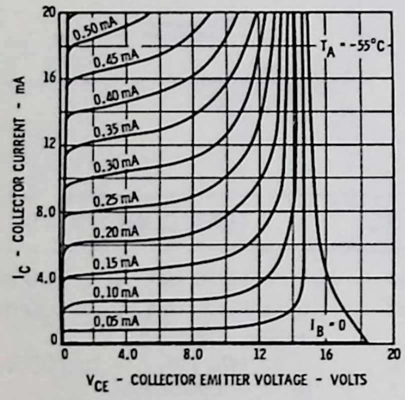
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

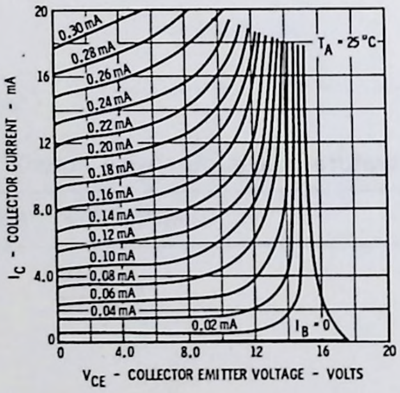
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

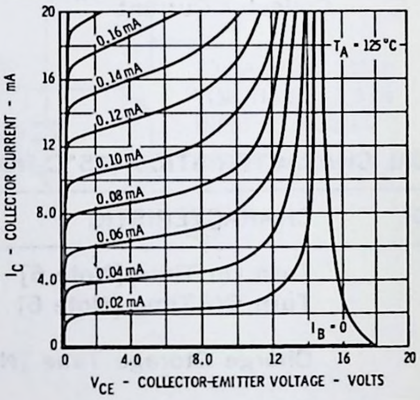
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	10	33			$I_C = 300$ mA	$V_{CE} = 0.5$ V
V_{BE} (sat)	Base Saturation Voltage		0.72	0.78	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Base Saturation Voltage		0.85	1.1	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE} (sat)	Base Saturation Voltage		1.1	1.3	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{BE} (sat)	Base Saturation Voltage		1.4	2.1	Volts	$I_C = 1000$ mA	$I_B = 100$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.17	0.25	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)(+125°C)	Collector Saturation Voltage		0.3	0.5	Volts	$I_C = 300$ mA	$I_B = 30$ mA
I_{CES}	Collector Reverse Current			100	μA	$V_{CE} = 10$ V	$V_{EB} = 0$
C_{TE}	Emitter Transition Capacitance		15	25	pf	$V_{EB} = 0.5$ V	$I_C = 0$
C_{ob}	Output Capacitance		6.0	15	pf	$V_{CB} = 5.0$ V	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	25			Volts	$I_C = 0.5$ mA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	12			Volts	$I_C = 30$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	$I_E = 0.1$ mA	$I_C = 0$

TYPICAL COLLECTOR CHARACTERISTICS*

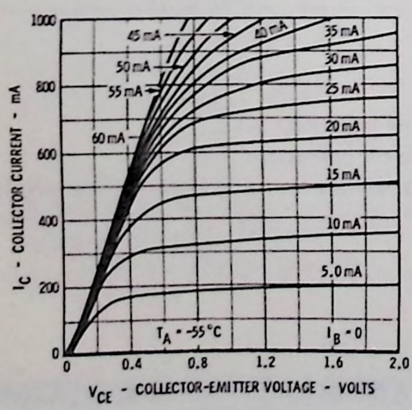
ACTIVE REGION

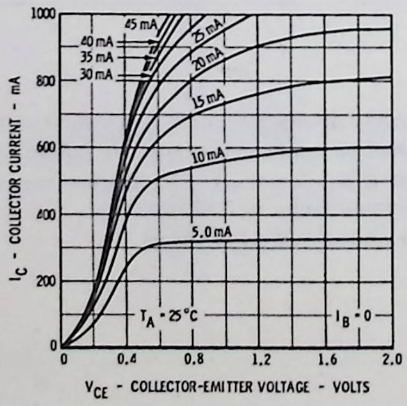


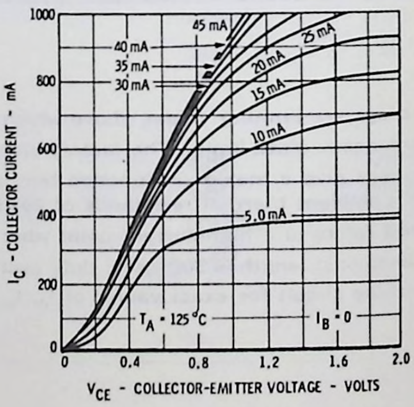




SATURATION REGION



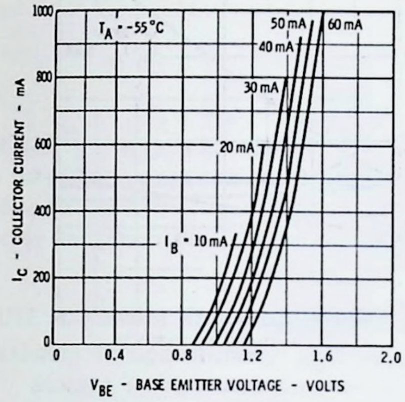


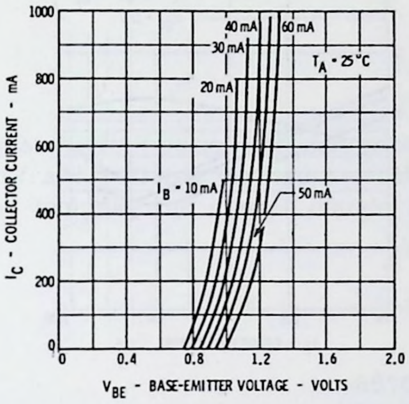


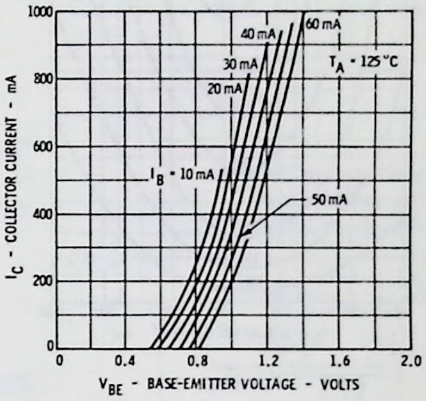
* Single family characteristics on Transistor Curve Tracer.

TYPICAL BASE CHARACTERISTICS*

SATURATION REGION

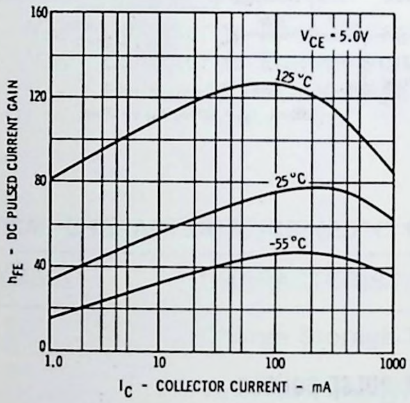




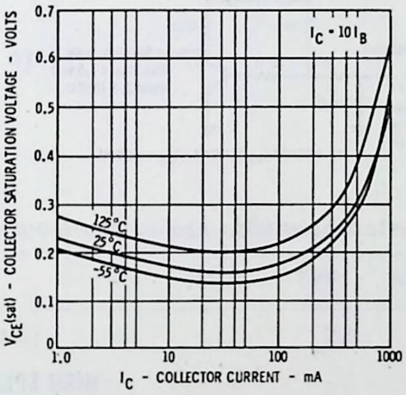


TYPICAL ELECTRICAL CHARACTERISTICS

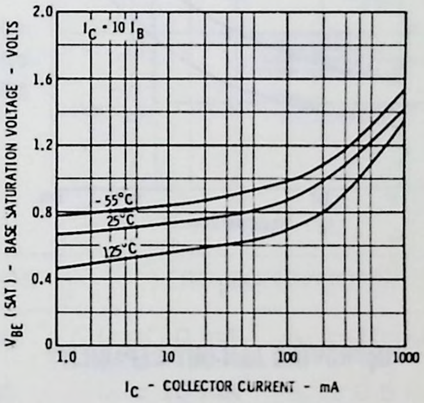
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



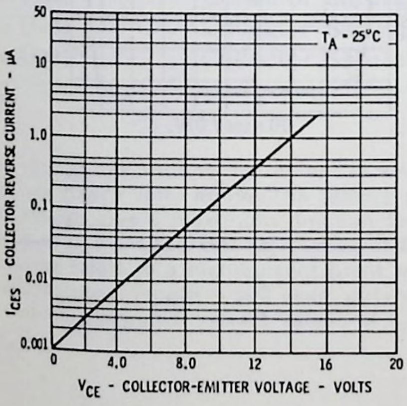
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRRENT



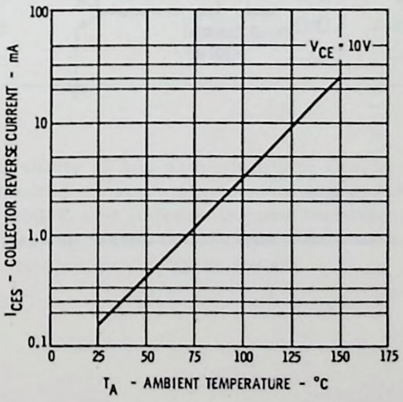
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



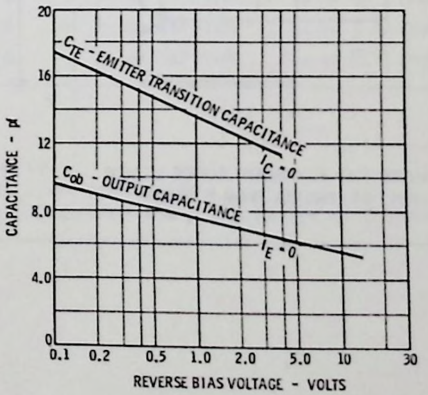
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



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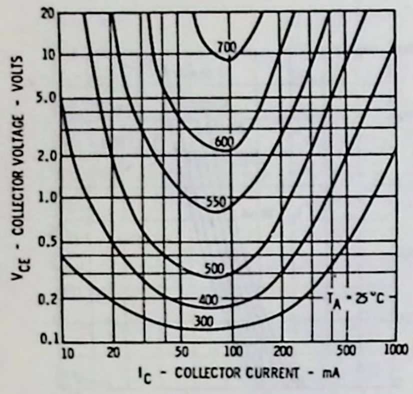
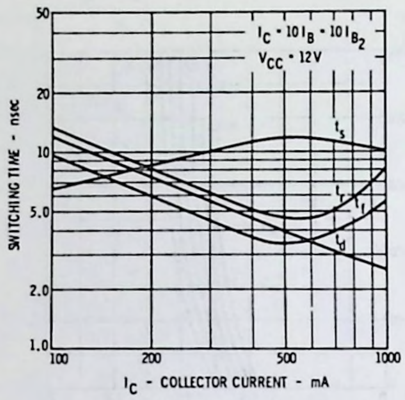
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

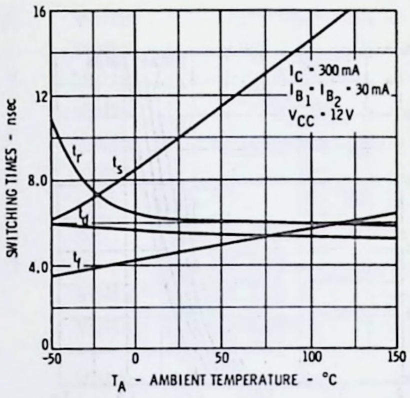
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



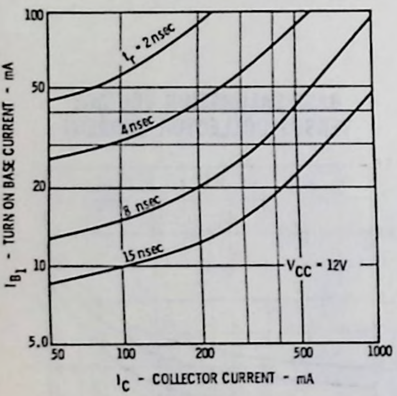
SWITCHING TIMES VERSUS COLLECTOR CURRENT



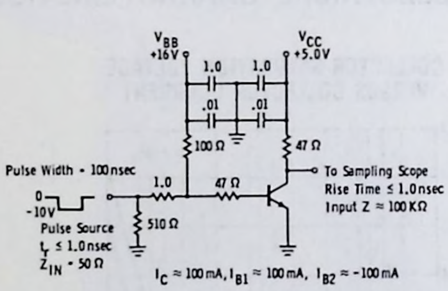
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT

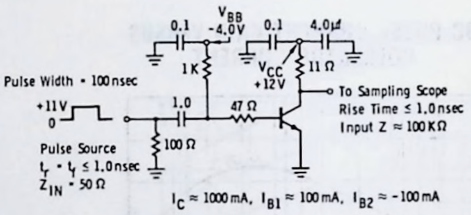


CHARGE STORAGE TIME MEASUREMENT CIRCUIT


V_{BB} +16V
V_{CC} +5.0V
1.0
1.0
.01
.01
100 Ω
47 Ω
To Sampling Scope
Rise Time ≤ 1.0 nsec
Input Z ≈ 100 KΩ
Pulse Width = 100 nsec
0
-10V
1.0
47 Ω
510 Ω
Pulse Source
$t_r ≤ 1.0 nsec$
$Z_{IN} = 50 Ω$

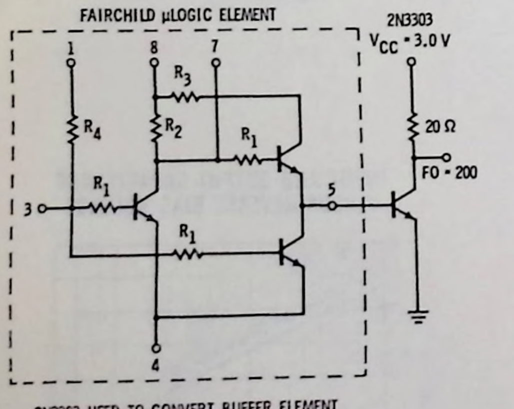
$I_C ≈ 100 mA, I_{B1} ≈ 100 mA, I_{B2} ≈ -100 mA$

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT


V_{BB} -4.0V
0.1
0.1
4.0µf
1K
V_{CC} +12V
11 Ω
Pulse Width = 100 nsec
+11V
0
1.0
47 Ω
To Sampling Scope
Rise Time ≤ 1.0 nsec
Input Z ≈ 100 KΩ
100 Ω
Pulse Source
$t_r = t_f ≤ 1.0 nsec$
$Z_{IN} = 50 Ω$

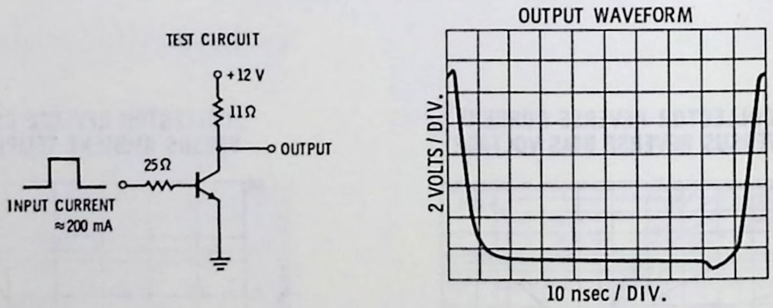
$I_C ≈ 1000 mA, I_{B1} ≈ 100 mA, I_{B2} ≈ -100 mA$

IMPROVING FAN-OUT CAPABILITY


FAIRCHILD µLOGIC ELEMENT
1
8
7
R_3
R_4
R_2
R_1
R_1
R_1
3
5
4
2N3303
$V_{CC} = 3.0 V$
20 Ω
FO = 200

2N3303 USED TO CONVERT BUFFER ELEMENT (Part #900) FAN OUT FROM 25 TO 200

HIGH SPEED 1 AMPERE PULSE SOURCE


TEST CIRCUIT

OUTPUT WAVEFORM
+12 V
11Ω
OUTPUT
25Ω
INPUT CURRENT
≈200 mA
2 VOLTS / DIV.
10 nsec / DIV.

2N3304

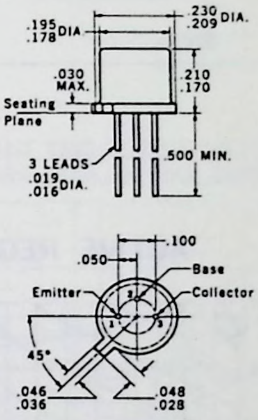
PNP HIGH-SPEED SWITCH

SILICON PLANAR EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE USE 2N4207 SERIES

he **2N3304** is a very high speed PNP silicon epitaxial PLANAR device intended primarily for use high speed logic application. A 500 mc minimum f_T and a 30 nsec maximum τ_s make it an ideal ternative to germanium devices for applications requiring the greater margin of reliability forded by its silicon PLANAR construction.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	**−65°C** to **+200°C**
Operating Junction Temperature	**200°C** Maximum
Lead Temperature (Soldering, 60 sec time limit)	**300°C** Maximum

Maximum Power Dissipation

Total Dissipation at 100°C Case Temperature [Notes 2 and 3]	**0.5** Watt
at 25°C Ambient Temperature [Notes 2 and 3]	**0.3** Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	**−6.0** Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	**−6.0** Volts
V_{EBO}	Emitter to Base Voltage	**−4.0** Volts

LECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
τ_s	Charge Storage Time [Note 6]		22	30	nsec	$I_C \approx 10$ mA $I_{B1} \approx 10$ mA $I_{B2} \approx -10$ mA
t_{on}	Turn On Time [Note 6]		27	60	nsec	$I_C \approx 10$ mA $I_{B1} \approx 0.5$ mA
t_{off}	Turn Off Time [Note 6]		34	60	nsec	$I_C \approx 10$ mA $I_{B1} \approx 0.5$ mA $I_{B2} \approx -0.5$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	5.0	7.0			$I_C = 10$ mA $V_{CE} = -5.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	63	120		$I_C = 10$ mA $V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	20	50			$I_C = 50$ mA $V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	15	60			$I_C = 1.0$ mA $V_{CE} = -0.5$ V
V_{CE} (sat)	Collector Saturation Voltage		−0.05	−0.15	Volts	$I_C = 1.0$ mA $I_B = 0.1$ mA
V_{CE} (sat)	Collector Saturation Voltage		−0.07	−0.16	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		−0.2	−0.5	Volts	$I_C = 50$ mA $I_B = 5.0$ mA

OTES:
1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 583°C/watt (derating factor of 1.72 mW/°C).
4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.
5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

FAIRCHILD TRANSISTOR 2N3304

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

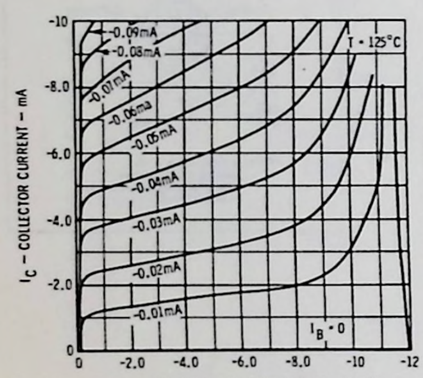
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12	33			$I_C = 10$ mA	$V_{CE} = -0.3$ V
V_{BE} (sat)	Base Saturation Voltage	−0.7	−0.76	−0.8	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{BE} (sat)	Base Saturation Voltage	−0.8	−0.88	−1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Base Saturation Voltage		−1.1	−1.5	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{CE} (sat)(125°C)	Collector Saturation Voltage		−0.09	−0.23	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
I_{CES}	Collector Reverse Current		0.003	10	nA	$V_{CE} = -3.0$ V	$V_{EB} = 0$
I_{CES} (125°C)	Collector Reverse Current		0.001	10	µA	$V_{CE} = -3.0$ V	$V_{EB} = 0$
C_{ob}	Output Capacitance		1.9	3.5	pf	$V_{CB} = -5.0$ V	$I_E = 0$
C_{TE}	Emitter Transition Capacitance		1.8	3.5	pf	$V_{EB} = -0.5$ V	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−6.0			Volts	$I_C = 100$ µA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−6.0			Volts	$I_C = 100$ µA	$I_B = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	−6.0			Volts	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	$I_E = 100$ µA	$I_C = 0$

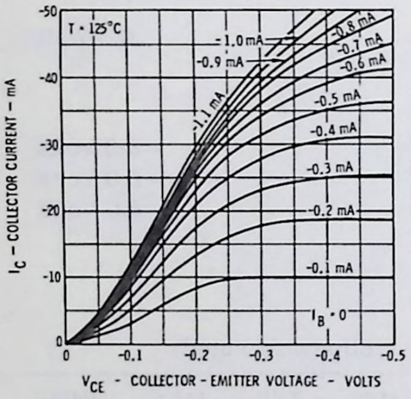
TYPICAL COLLECTOR AND BASE CHARACTERISTICS

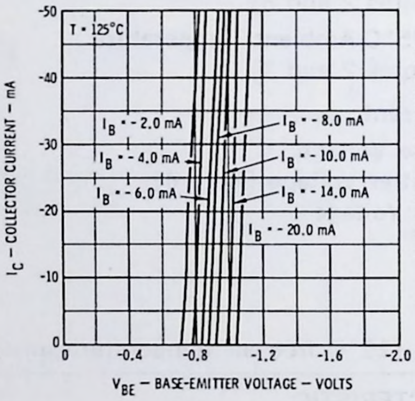
ACTIVE REGION

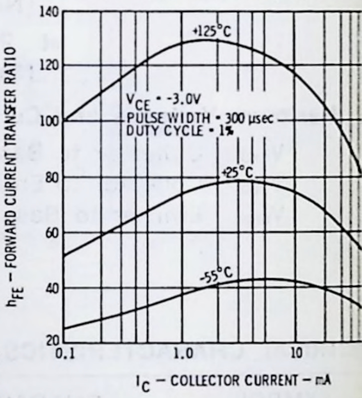
SATURATION REGION

PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT

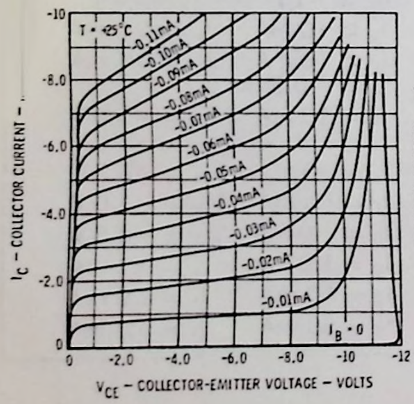


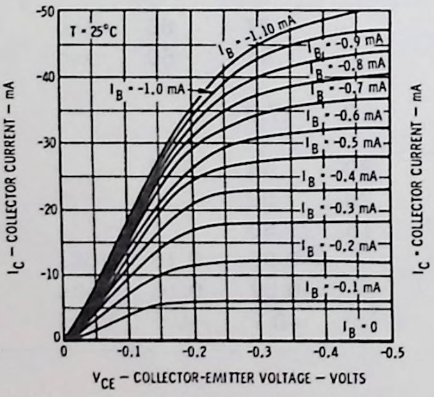


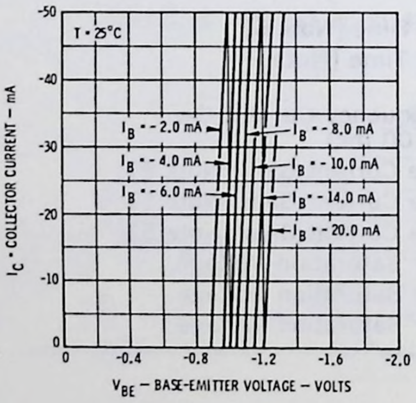


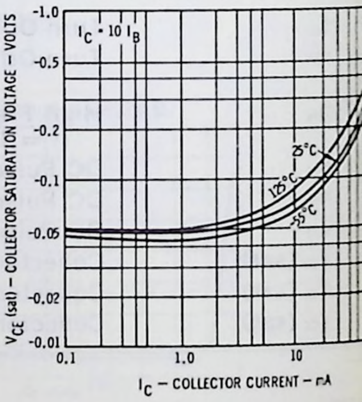


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

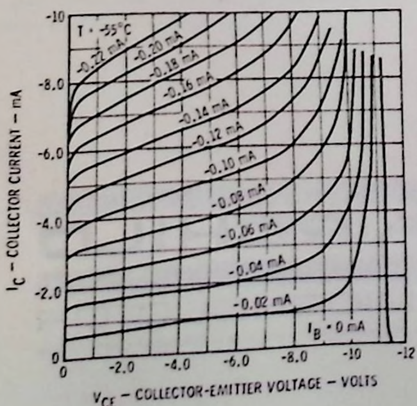


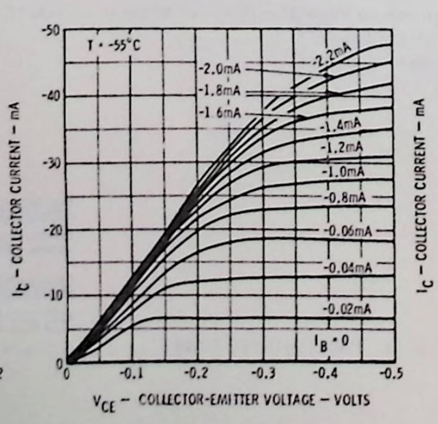


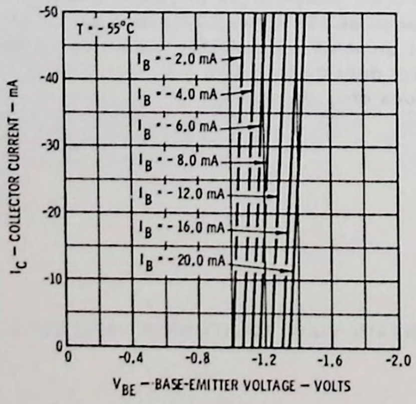


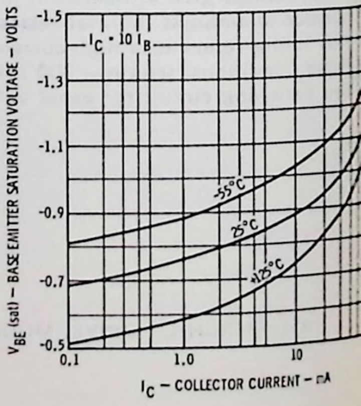


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

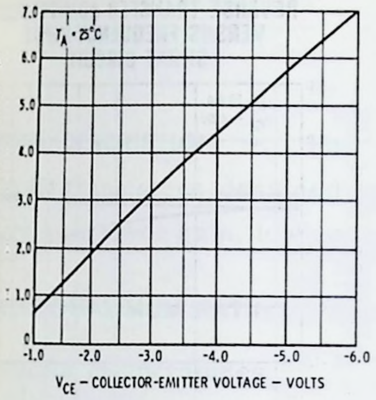




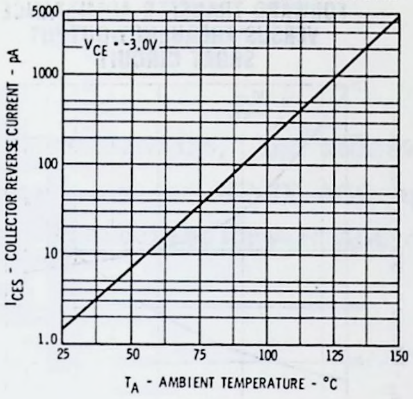




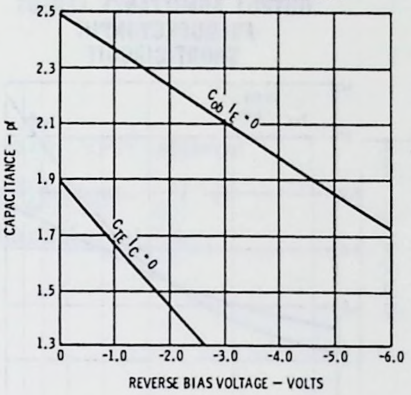
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



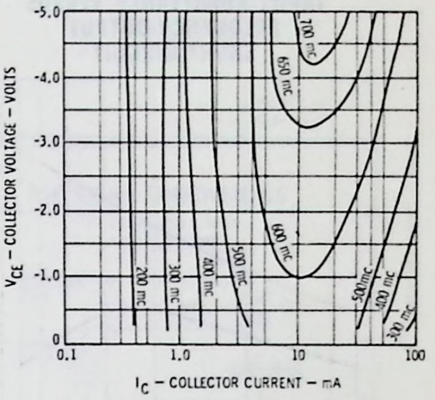
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



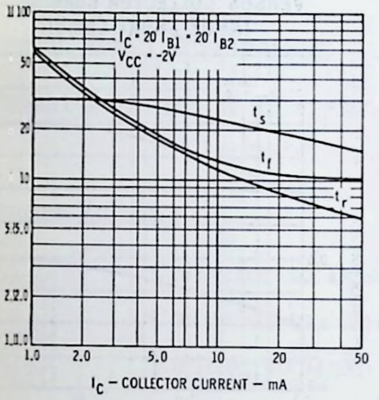
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



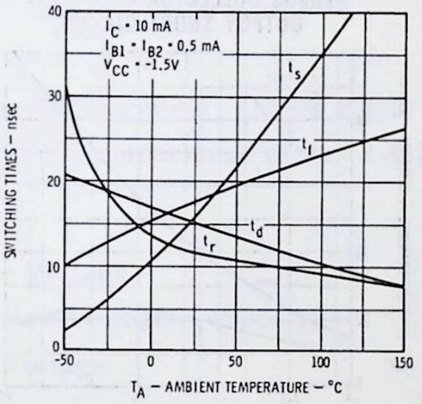
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



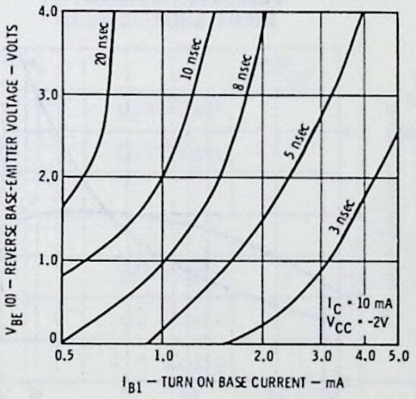
SWITCHING TIMES VERSUS COLLECTOR CURRENT



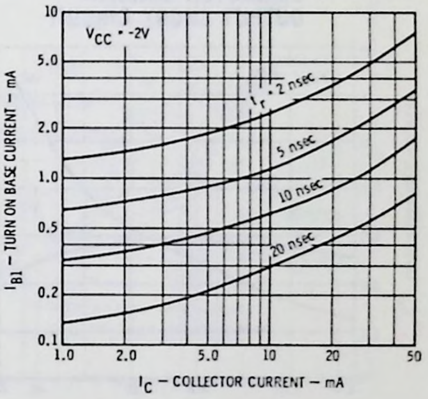
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



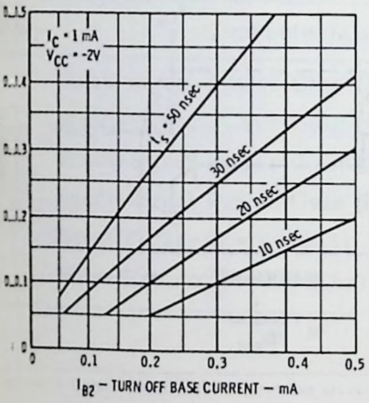
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



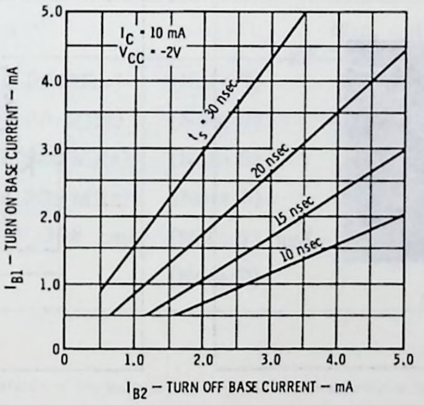
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



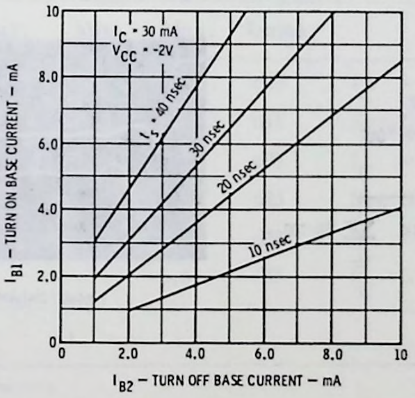
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



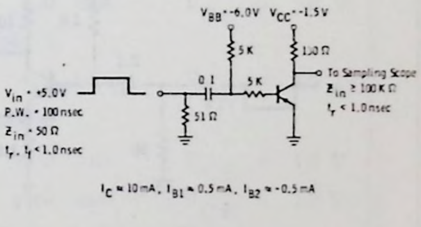
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



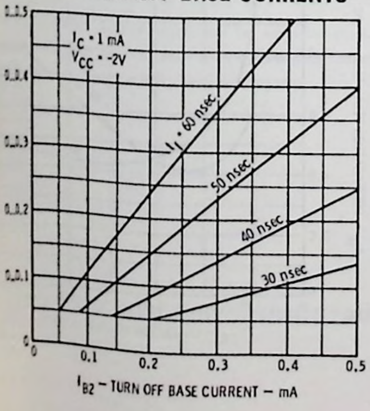
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



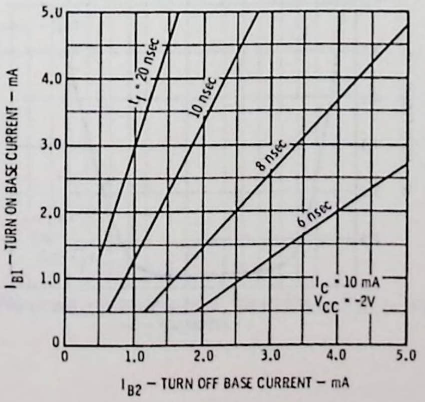
TURN ON AND TURN OFF TEST CIRCUIT


V_{BB} = -6.0V
V_{CC} = -1.5V
5 K
130 Ω
0.1
5 K
51 Ω
To Sampling Scope
Z_{in} ≥ 100 K Ω
t_r < 1.0 nsec
V_{in} = +5.0V
P.W. = 100 nsec
Z_{in} = 50 Ω
t_r, t_f < 1.0 nsec
I_C ≈ 10 mA, I_{B1} ≈ 0.5 mA, I_{B2} ≈ -0.5 mA

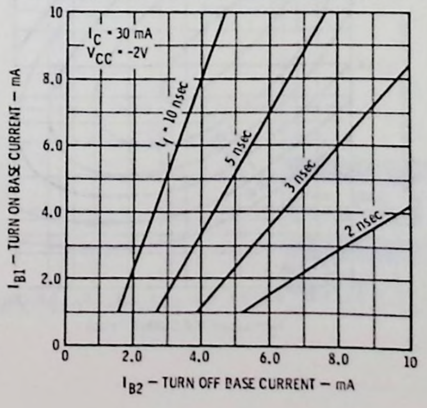
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



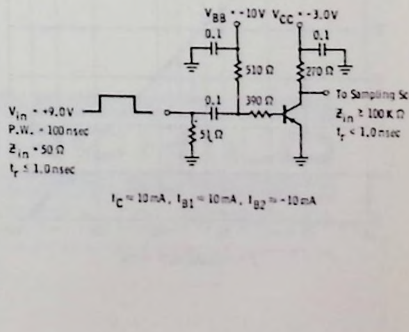
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

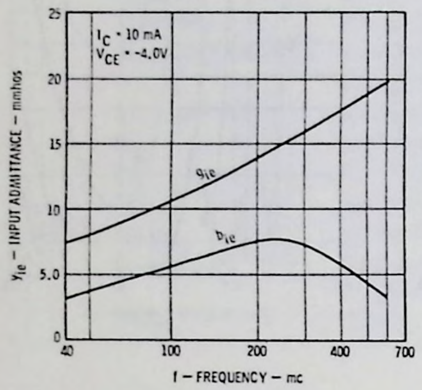


CHARGE STORAGE TIME TEST CIRCUIT

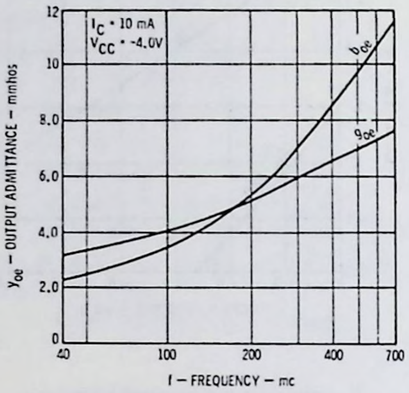

V_{BB} = -10V
V_{CC} = -3.0V
0.1
0.1
510 Ω
270 Ω
0.1
390 Ω
51 Ω
To Sampling Scope
Z_{in} ≥ 100 K Ω
t_r < 1.0 nsec
V_{in} = +9.0V
P.W. = 100 nsec
Z_{in} = 50 Ω
t_r ≤ 1.0 nsec
I_C ≈ 10 mA, I_{B1} ≈ 10 mA, I_{B2} ≈ -10 mA

TYPICAL COMMON EMITTER "Y" PARAMETERS

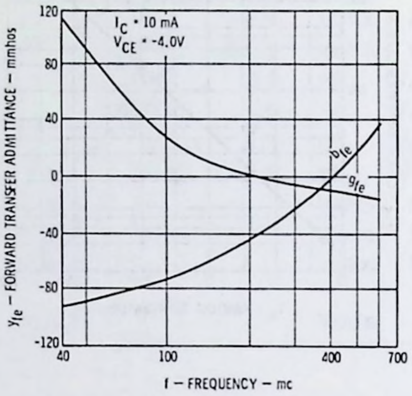
INPUT ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



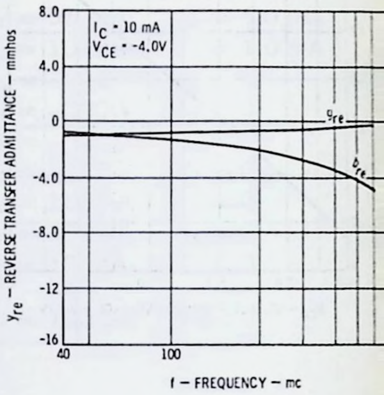
OUTPUT ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



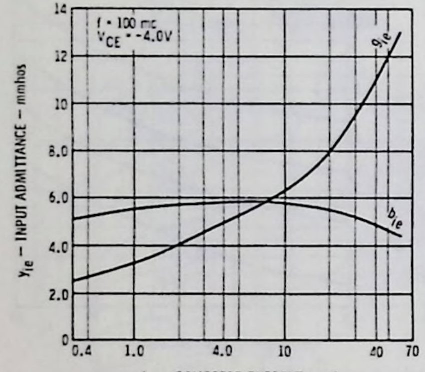
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



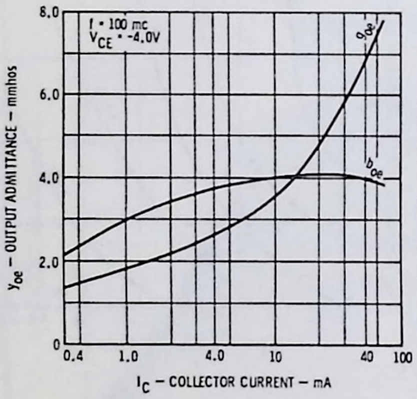
REVERSE TRANSFER ADMITTANC VERSUS FREQUENCY-INPUT SHORT CIRCUIT



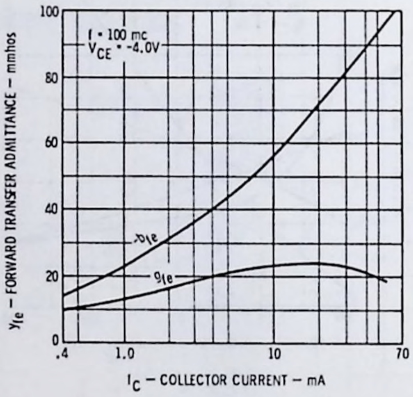
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



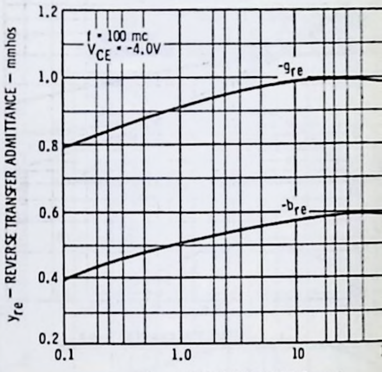
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



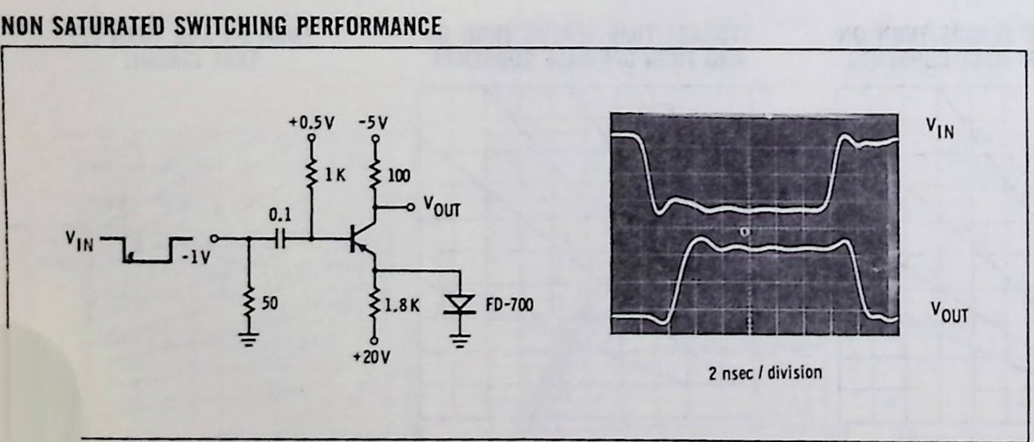
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



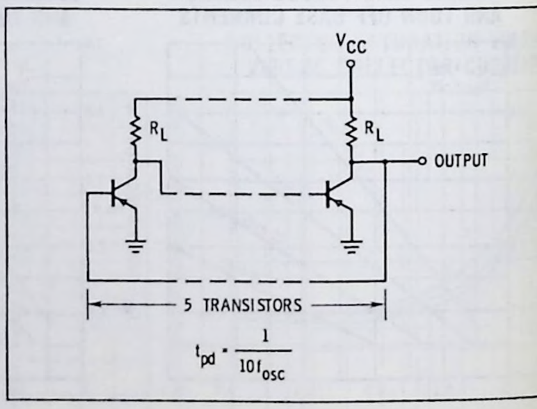
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



NON SATURATED SWITCHING PERFORMANCE

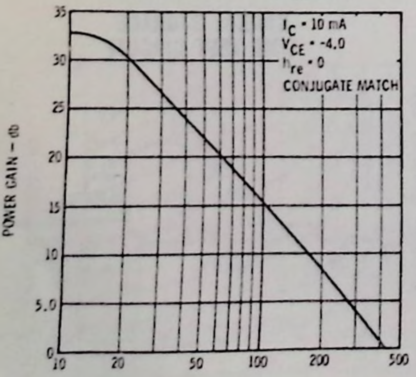


FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

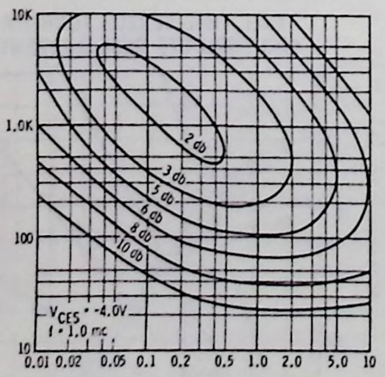


$$t_{pd} = \frac{1}{10 f_{osc}}$$

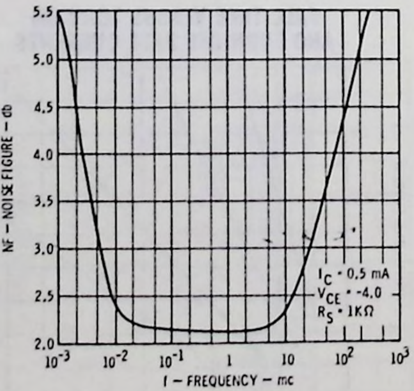
IDEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



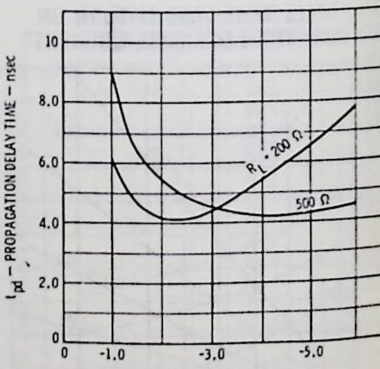
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



NOISE FIGURE VERSUS FREQUENCY



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



2N3337 · 2N3338 · 2N3339

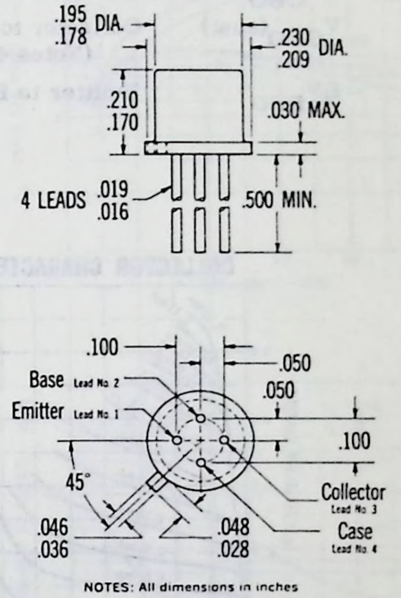
NPN RF-IF-AGC AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

NERAL DESCRIPTION — The 2N3337, 2N3338, and 2N3339 are NPN silicon LANAR transistors designed specifically for RF-IF-AGC applications. They ature high power gain, low noise, and excellent forward AGC characteristics.

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-72)



NOTES: All dimensions in inches
Leads are gold-plated kovar

SOLUTE MAXIMUM RATINGS [Note 1]

aximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (soldering, 60 sec. time limit)	300°C Maximum

aximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 & 3)	0.5 Watt
at 25°C Ambient Temperature (Notes 2 & 3)	0.3 Watt

aximum Voltages

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

mbol	Characteristics		2N3337 2N3338 Min.	2N3337 2N3338 Max.	2N3339 Min.	2N3339 Max.	Units	Test Conditions	
$_1$	Small-Signal Power Gain (f = 60 MHz)	(Note 7)	24				dB	I_C = 4.0 mA	V_{CE} = 10 V
$_2$	Small-Signal Power Gain (f = 60 MHz)	(Note 7)	-30				dB	See Note 5	
$_1$	Small-Signal Power Gain (f = 200 MHz)	(Note 8)			15		dB	I_C = 4.0 mA	V_{CE} = 10 V
$_2$	Small-Signal Power Gain (f = 200 MHz)	(Note 8)			-30		dB	See Note 6	
	Noise Figure (f = 60 MHz) 2N3338 only	(Note 7)		5.5			dB	I_C = 4.0 mA	V_{CE} = 10 V
	Noise Figure (f = 200 MHz)	(Note 8)				5.5	dB	I_C = 4.0 mA	V_{CE} = 10 V

S:

ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 350°C/Watt (derating factor of 2.86 mW/°C); junction-to- thermal resistance of 583°C/Watt (derating factor of 1.72 mW/°C).

rating refers to a high-current point where collector-to-emitter voltage is lowest.

$_1$ is ≤ G_{Pe_1} -30 dB when I_C is between 8.0 and 12 mA in the 60 MHz circuit on page 4. $V_{CE} = (12 - \frac{I_C}{2})$.

$_1$ is ≤ G_{Pe_1} - 30 dB when I_C is between 10 and 14 mA in the 200 MHz circuit on page 4. $V_{CE} = (12 - \frac{I_C}{2})$.

width = 10 MHz Source resistance (as seen by transistor) = 200 Ω.

width = 8.0 MHz Source resistance (as seen by transistor) = 100 Ω.

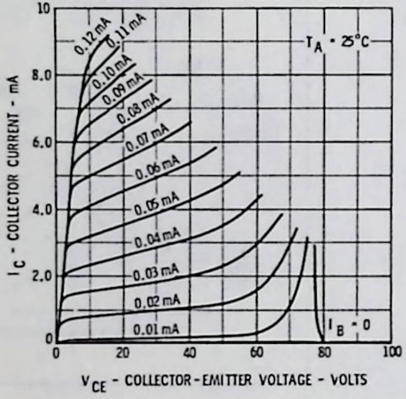
Conditions: length = 300 μsec; duty cycle = 1%.

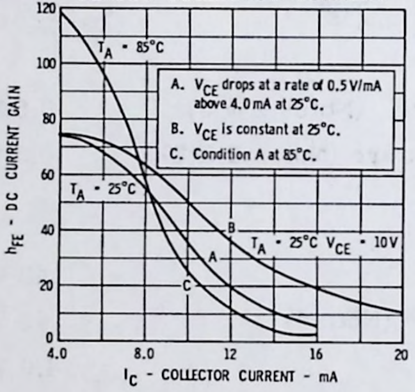
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

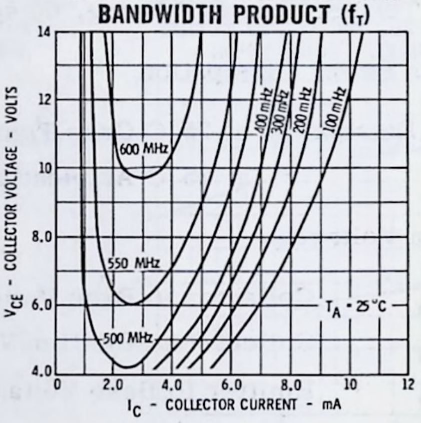
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

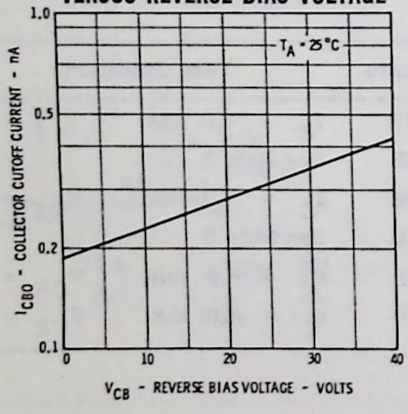
Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain	30			I_C = 4.0 mA	V_{CE} = 10 V
I_{CBO}	Collector Cutoff Current		25	nA	I_E = 0	V_{CB} = 20 V
I_{CBO}(125°C)	Collector Cutoff Current		5.0	μA	I_E = 0	V_{CB} = 20 V
C_{ob}	Output Capacitance		1.6	pf	I_E = 0	V_{CB} = 10 V
h_{fe}	High Frequency Current Gain (f = 100 mc)	4.0			I_C = 4.0 mA	V_{CE} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	40		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 9)	40		Volts	I_C = 3.0 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		Volts	I_E = 100 μA	I_C = 0

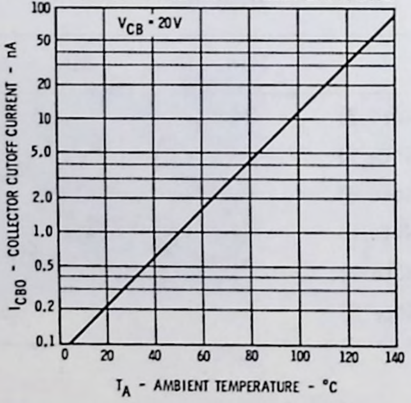
TYPICAL ELECTRICAL CHARACTERISTICS

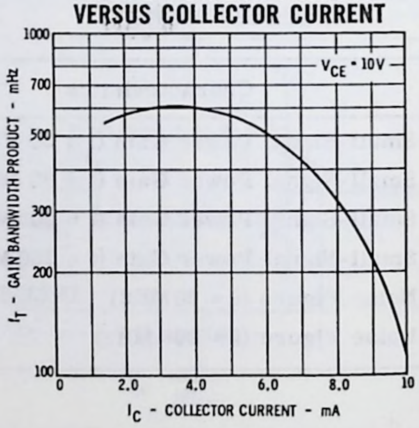

COLLECTOR CHARACTERISTICS*

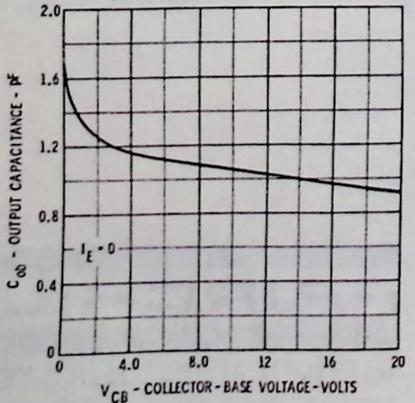

DC CURRENT GAIN VERSUS COLLECTOR CURRENT

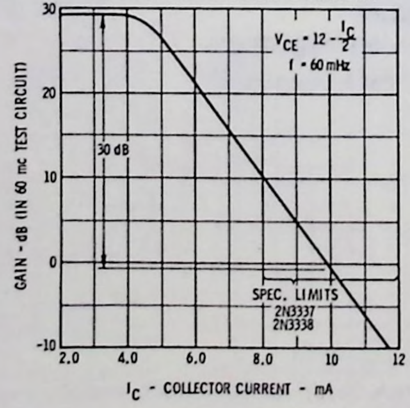

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

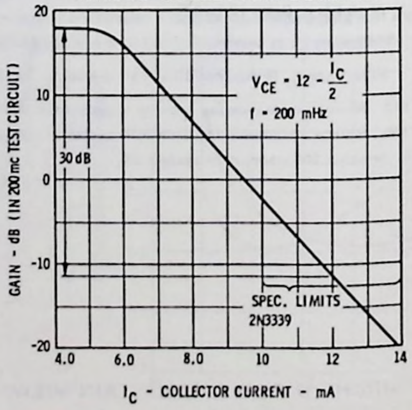

COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE


COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE


GAIN-BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT


OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE


TYPICAL GAIN VERSUS COLLECTOR CURRENT


TYPICAL GAIN VERSUS COLLECTOR CURRENT

* Single family characteristics on Transistor Curve Tracer

TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

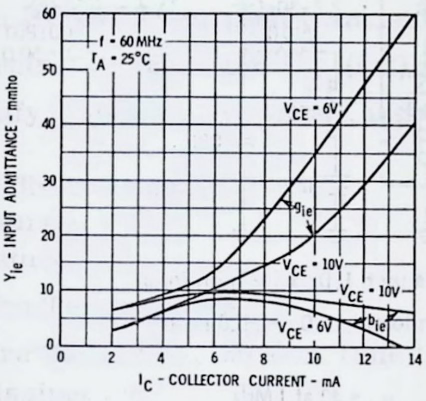
60 MHz

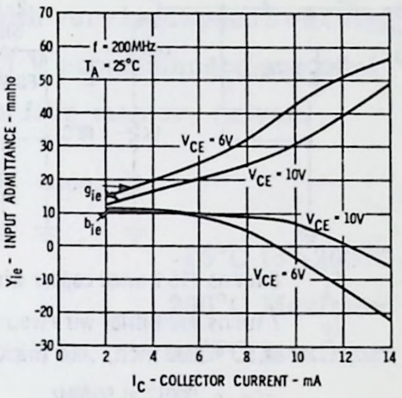
200 MHz

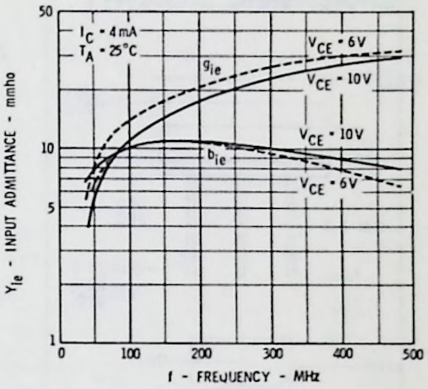
vs. FREQUENCY

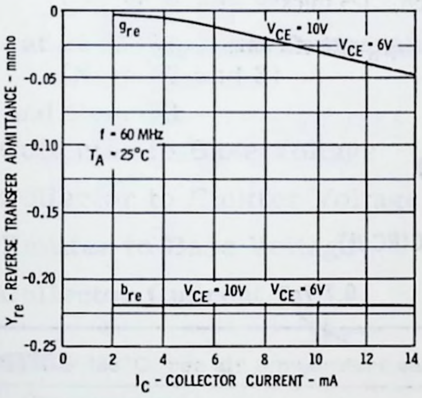
vs. COLLECTOR CURRENT

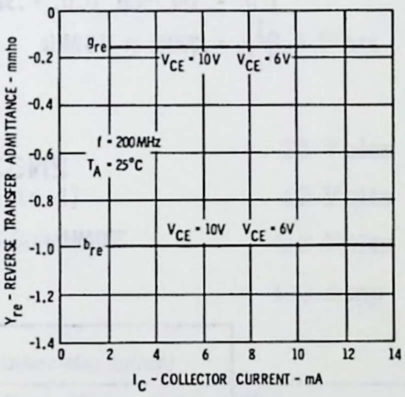
vs. COLLECTOR CURRENT

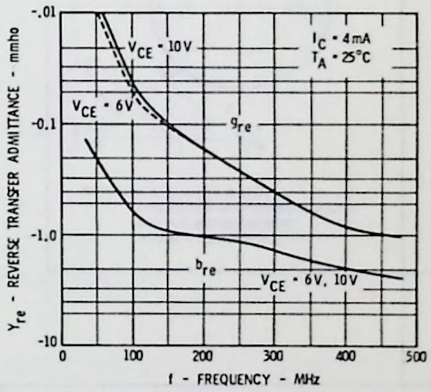


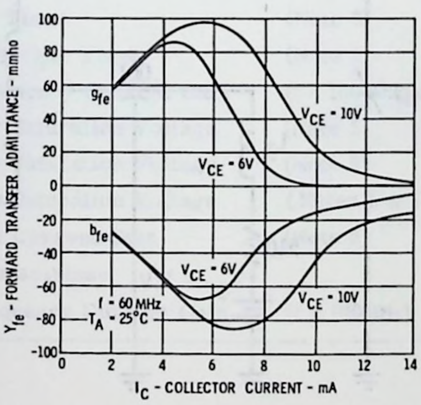


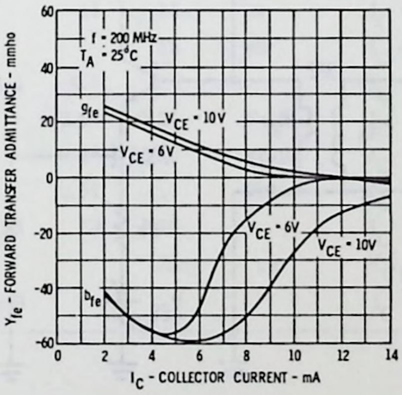


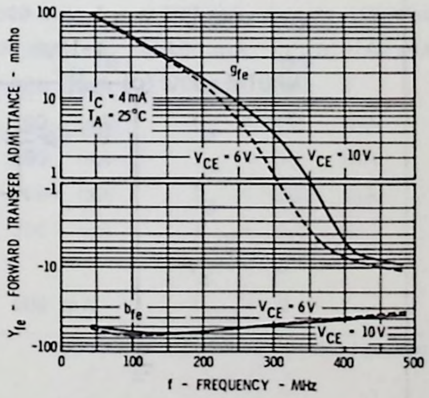


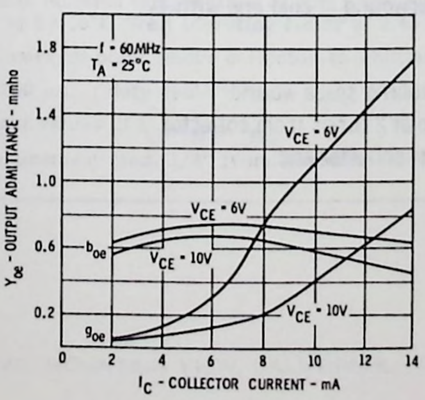


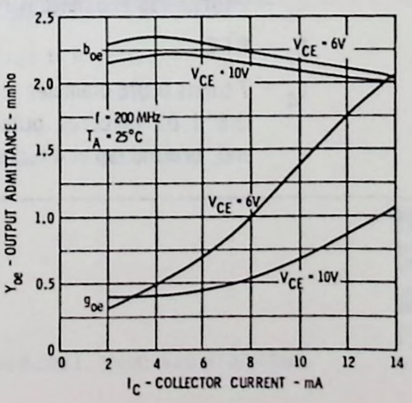


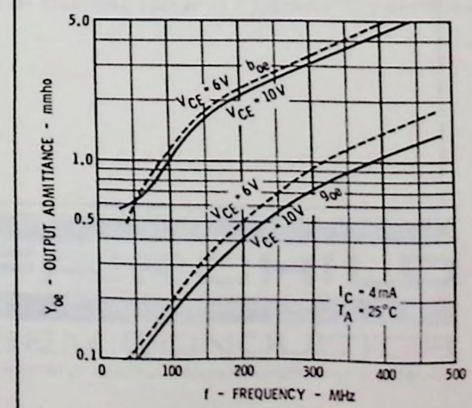






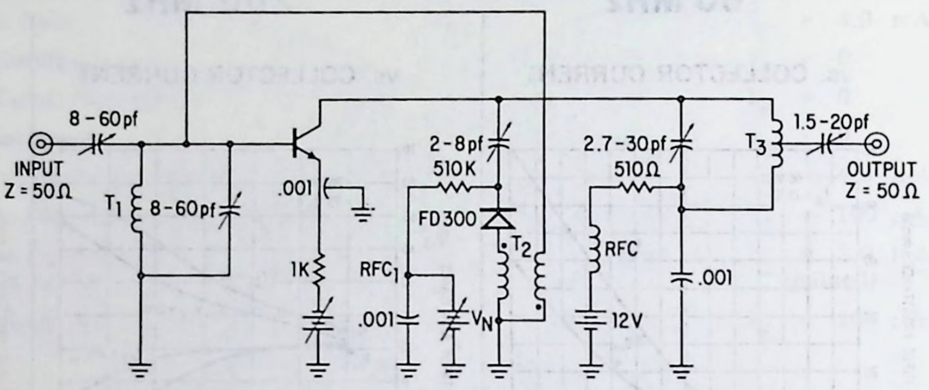






2N3337 - 2N3338

60MHz AGC TEST CIRCUIT


8 - 60pf
INPUT
Z = 50Ω
T1
8-60pf
.001
1K
RFC1
.001
VN
2-8pf
510K
FD300
T2
2.7-30pf
510Ω
RFC
.001
12V
T3
1.5-20pf
OUTPUT
Z = 50Ω

T_1 8 turns #16 tinned copper wire 1/4 inch I.D. x 1/2 inch long.

T_2 7 turns #32 Bifilar wire wound on toroid, I.D. = .120 inch, O.D. = .230 inch, .060 thick.

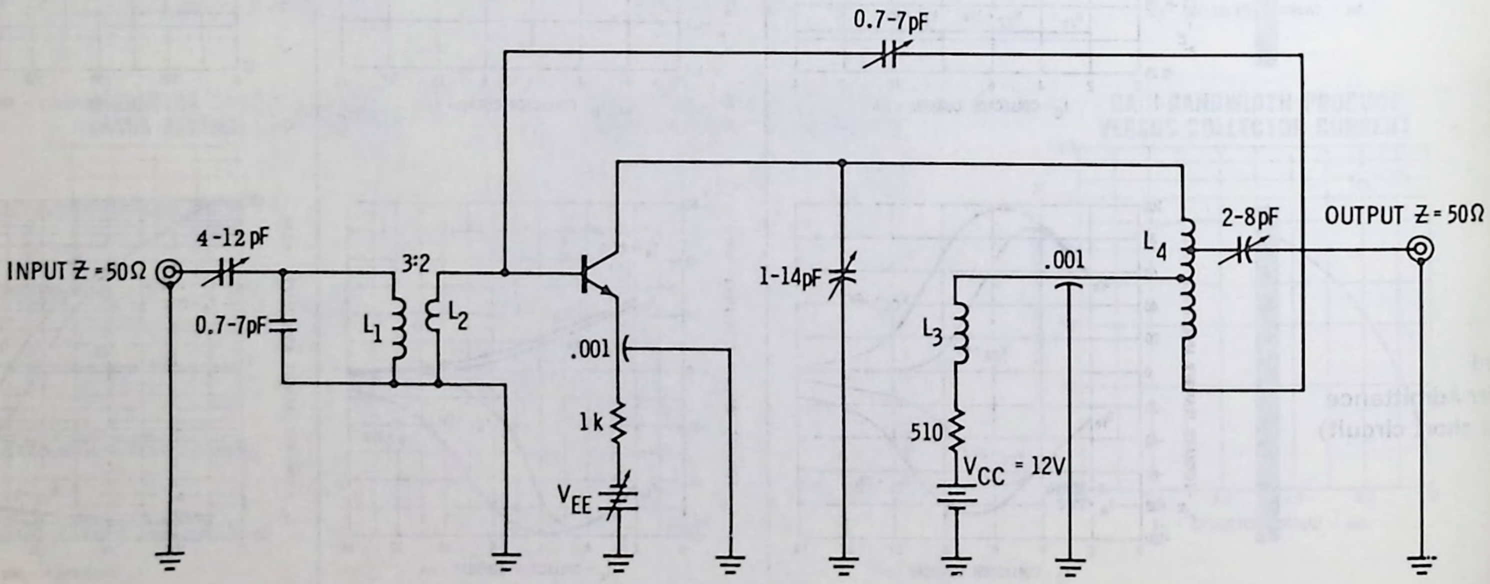
$\frac{1}{\mu_0 Q}$ = .00017 at 50 MHz μ_0 = 40 at 1 MHz

T_3 8 1/2 turns #26 enameled wire, center-tapped, wound on toroid, I.D. = .187 inch, O.D. = .375 inch, .125 thick.

$\frac{1}{\mu_0 Q}$ = .00042 at 150 MHz μ_0 = 16 at 1 MHz

2N3339

200MHz AGC TEST CIRCUIT


0.7-7pF
4-12pF
INPUT Z = 50Ω
0.7-7pF
L1
3:2
L2
.001
1k
VEE
1-14pF
.001
L3
510
VCC = 12V
L4
2-8pF
OUTPUT Z = 50Ω

L_1 - 3 turns #18 enameled wire on 1/4" ceramic core.

L_2 - 2 turns #18 enameled wire interwound at cold end with L_1.

L_3 - RFC

L_4 - 7 turns 0.076 diameter silver tubing space wound (3/8" I.D., no core), output tap at 2 turns from collector end, ground tap at 4 turns from collector end.

2N3426

NPN HIGH-SPEED, HIGH CURRENT, SWITCH

SILICON PLANAR* EPITAXIAL TRANSISTOR

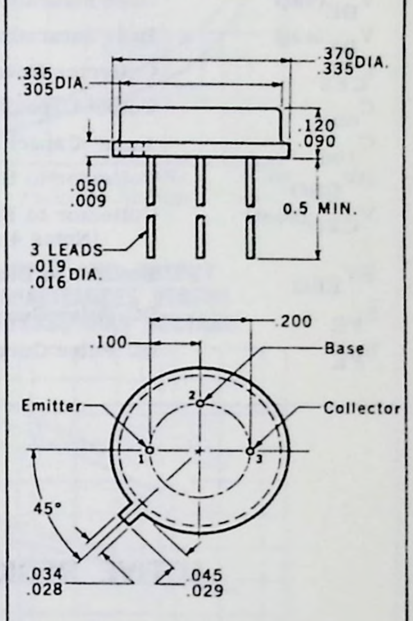
GENERAL DESCRIPTION

The 2N3426 is a silicon PLANAR epitaxial transistor with very high speed switching capability at high currents. A maximum V_{CE}(sat) of 0.7 V at one ampere and minimum f_T of 450 MHz qualify it especially for use as a thin film memory driver.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		-65°C to +200°C
Operating Junction Temperature		200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)		300°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		3.0 Watts
at 25°C Ambient Temperature (Notes 2 and 3)		0.6 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	25 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	12 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Collector Current	1.0 Amp

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Collector internally connected to case
Leads are gold plated kovar
Package weight is 0.98 gram

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic		Min.	Typ.	Max.	Units	Test Conditions
t_{on}	Turn On Time	(Note 6)		10	15	ns	I_C ≈ 1000 mA I_{B1} ≈ 100 mA
t_{off}	Turn Off Time	(Note 6)		15	25	ns	I_C ≈ 1000 mA, I_{B1} ≈ 100 mA, I_{B2} ≈ -100 mA
t_s	Charge Storage Time	(Note 6)			15	ns	I_C ≈ 100 mA, I_{B1} ≈ 100 mA, I_{B2} ≈ -100 mA
h_{fe}	High Frequency Current Gain	(f = 100MHz)	4.5	6.5			I_C = 100 mA V_{CE} = 5.0 V
V_{CE}(sat)	Collector Saturation Voltage	(Note 5)		0.18	0.23	Volts	I_C = 100 mA I_B = 10 mA
V_{CE}(sat)	Collector Saturation Voltage	(Note 5)		0.24	0.33	Volts	I_C = 300 mA I_B = 30 mA
V_{CE}(sat)	Collector Saturation Voltage	(Notes 5 & 7)		0.51	0.7	Volts	I_C = 1000 mA I_B = 100 mA
h_{FE}	DC Pulse Current Gain	(Note 5)	30	60	120		I_C = 300 mA V_{CE} = 0.5 V
C_{obo}	Output Capacitance				25	pF	V_{CB} = 0 I_E = 0
h_{fe}	High Frequency Current Gain	(f = 100MHz)	2.0				I_C = 500 mA V_{CB} = 0

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C); junction-to-ambient thermal resistance of 291.6°C/Watt (derating factor of 3.43 mW/°C).
4. This rating refers to a high-current point where collector-to-emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs ; duty cycle = 1%.
6. See switching circuit for exact values of I_C, I_{B1}, I_{B2}.
7. This limit applies for a measurement made 1/4" from the bottom of the case.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

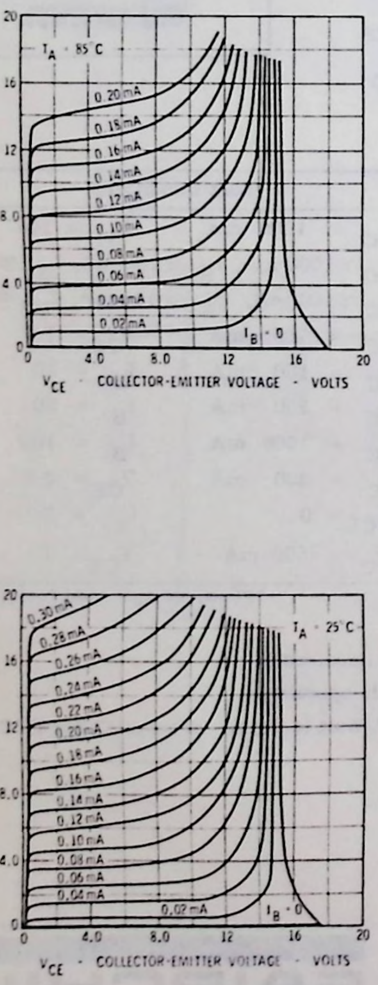
FAIRCHILD TRANSISTOR 2N3426

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

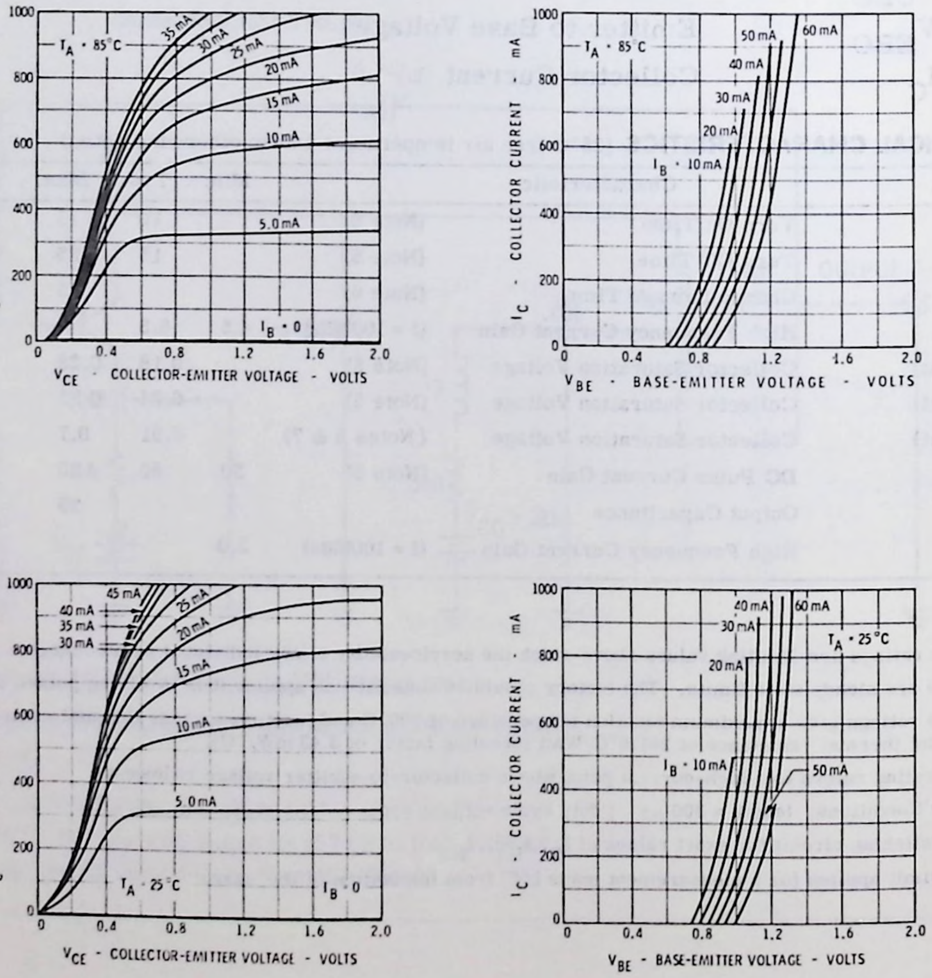
Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions	
V_{CE}(sat)	Collector Saturation Voltage		0.17	0.25	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat) (85°C)	Collector Saturation Voltage (Note 5)		0.25	0.5	Volts	I_C = 300 mA	I_B = 30 mA
V_{BE}(sat)	Base Saturation Voltage		0.68	0.78	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.84	1.1	Volts	I_C = 100 mA	I_B = 10 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.0	1.3	Volts	I_C = 300 mA	I_B = 30 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)	0.9	1.36	2.1	Volts	I_C = 1000 mA	I_B = 100 mA
I_{CES}	Collector Reverse Current		1.5	100	μA	V_{CE} = 15 V	V_{EB} = 0
C_{obo}	Output Capacitance		6.2	15	pF	I_E = 0	V_{CB} = 5.0 V
C_{ibo}	Input Capacitance		14.8	25	pF	I_C = 0	V_{EB} = 0.5 V
BV_{CBO}	Collector to Base Breakdown Voltage	25			Volts	I_C = 500 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	12			Volts	I_C = 30 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	I_E = 100 μA	I_C = 0
h_{FE}	DC Pulse Current Gain (Note 5)	30	50			I_C = 100 mA	V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	45			I_C = 10 mA	V_{CE} = 0.5 V

TYPICAL COLLECTOR AND BASE CHARACTERISTICS *

ACTIVE REGION



SATURATION REGION

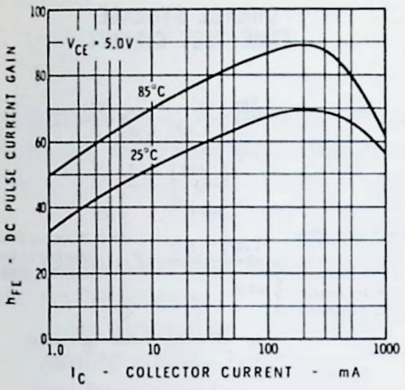


* Single family characteristics on Transistor Curve Tracer.

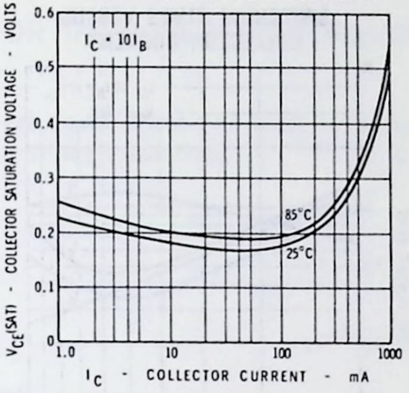
FAIRCHILD TRANSISTOR 2N3426

TYPICAL ELECTRICAL CHARACTERISTICS

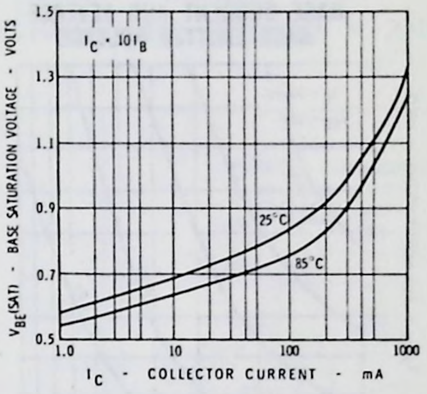
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



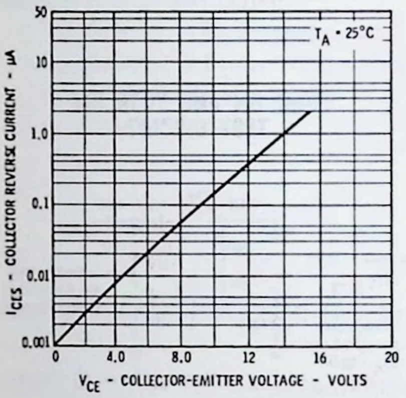
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



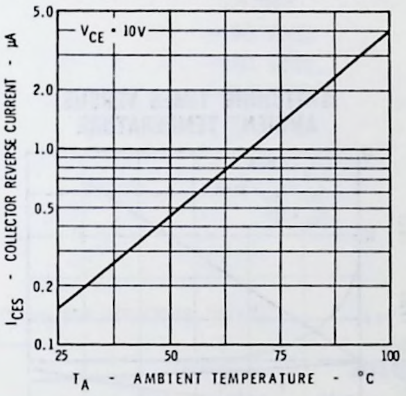
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



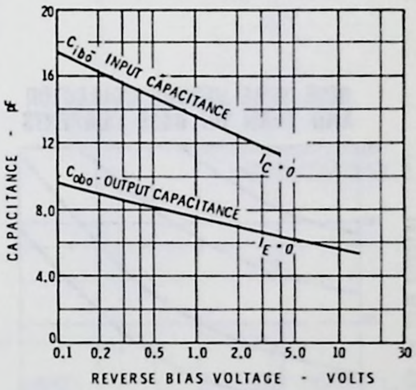
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



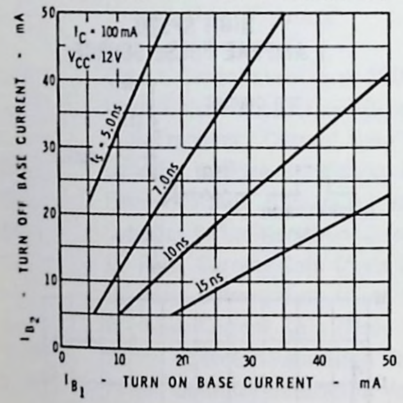
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



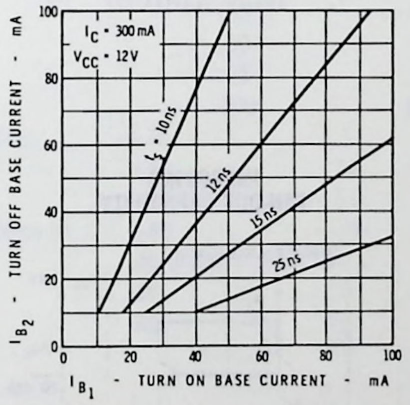
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



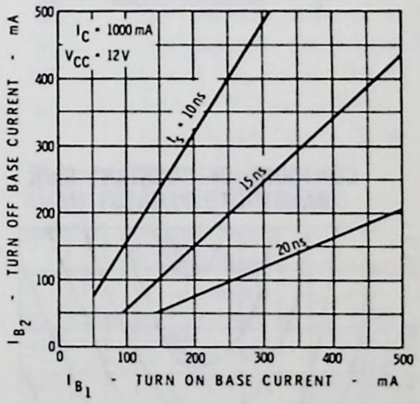
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



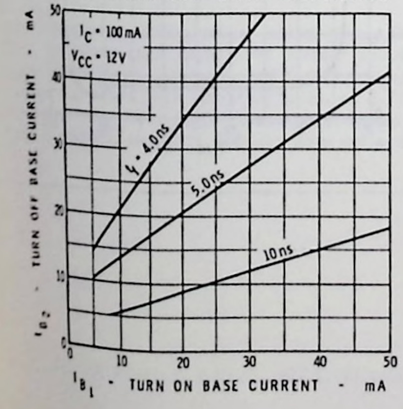
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



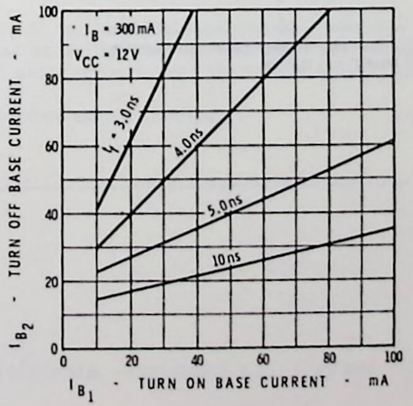
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



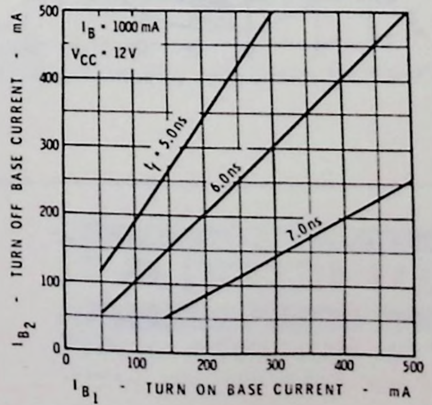
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

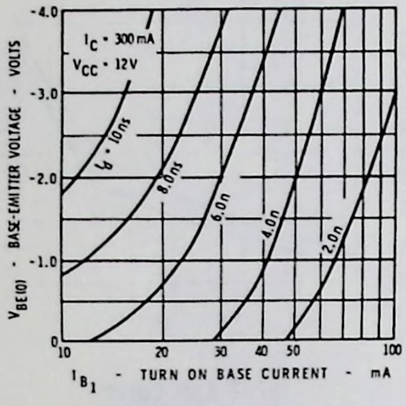


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

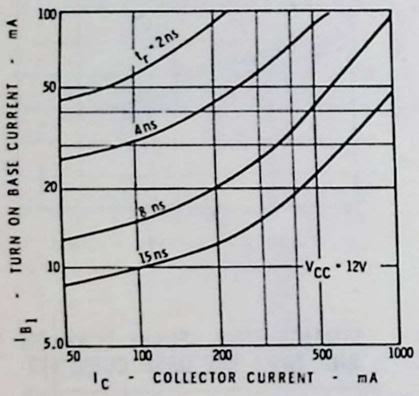


TYPICAL ELECTRICAL CHARACTERISTICS

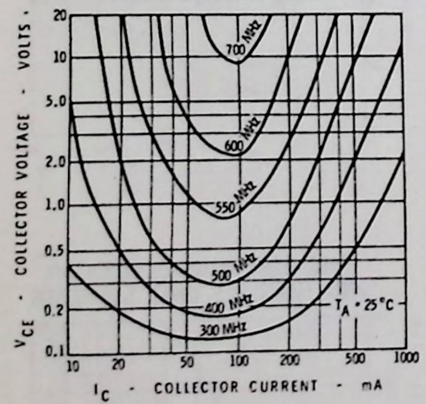
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



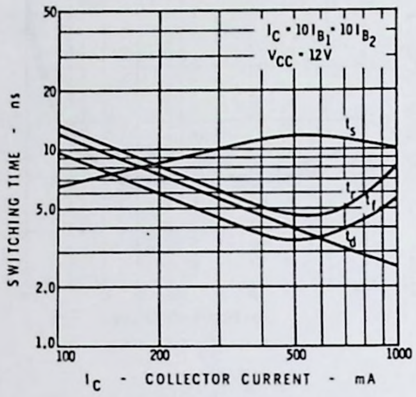
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



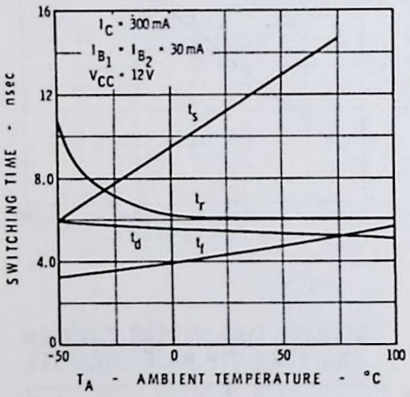
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



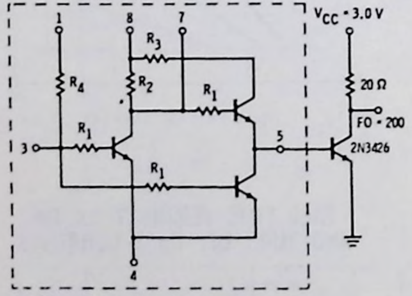
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

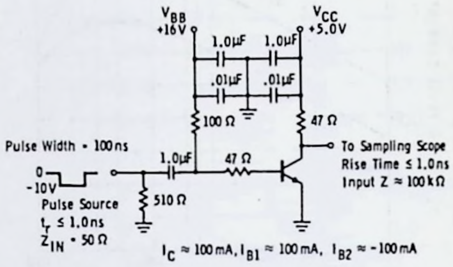


IMPROVING FAN-OUT CAPABILITY

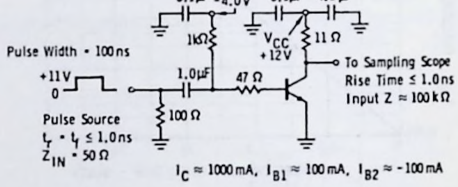

FAIRCHILD µLOGIC ELEMENT
1
8
7
3
5
4
R_4
R_3
R_2
R_1
R_1
R_1
V_{CC} = 3.0 V
20 Ω
FO = 200
2N3426

2N3426 used to convert buffer element (Part #900) FAN-OUT from 25 to 200.

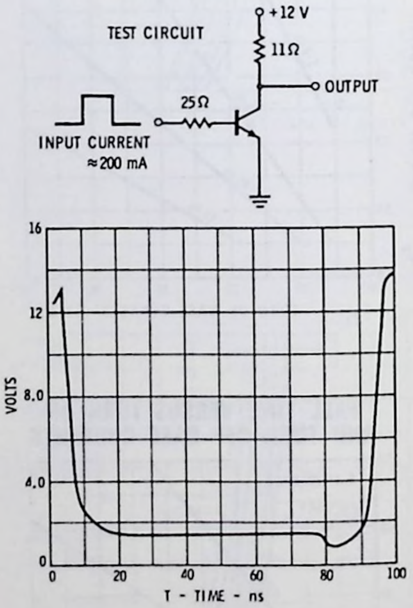
CHARGE STORAGE TIME TEST CIRCUIT


V_{BB} +16V
V_{CC} +5.0V
1.0µF
1.0µF
.01µF
.01µF
100 Ω
47 Ω
Pulse Width = 100ns
0
-10V
1.0µF
47 Ω
510 Ω
Pulse Source
t_r ≤ 1.0ns
Z_{IN} = 50 Ω
To Sampling Scope
Rise Time ≤ 1.0ns
Input Z ≈ 100 kΩ
I_C ≈ 100 mA, I_{B1} ≈ 100 mA, I_{B2} ≈ -100 mA

TURN ON AND TURN OFF TEST CIRCUIT


0.1µF
V_{BB} -4.0V
0.1µF
4.0µF
1kΩ
V_{CC} +12V
11 Ω
Pulse Width = 100ns
+11V
0
1.0µF
47 Ω
100 Ω
Pulse Source
t_r = t_f ≤ 1.0ns
Z_{IN} = 50 Ω
To Sampling Scope
Rise Time ≤ 1.0ns
Input Z ≈ 100 kΩ
I_C ≈ 1000 mA, I_{B1} ≈ 100 mA, I_{B2} ≈ -100 mA

HIGH SPEED 1 AMPERE PULSE SOURCE


TEST CIRCUIT
+12 V
11Ω
OUTPUT
25Ω
INPUT CURRENT
≈200 mA
16
12
8.0
4.0
0
0
20
40
60
80
100
VOLTS
T - TIME - ns

2N3467 · 2N3468

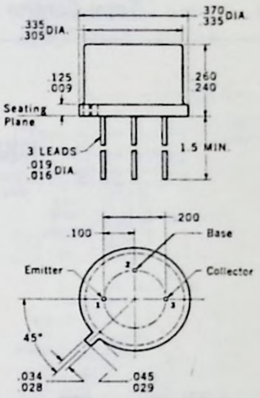
PNP HIGH-SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N5022 • 2N5023

GENERAL DESCRIPTION — The 2N3467 and 2N3468 are low power, silicon PNP triode transistors designed primarily for high speed saturated switching and for core driving applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		+200°C
Lead Temperature (soldering, 10 second time limit)		+230°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Ambient Temperature		1.0 Watt
at 25°C Case Temperature		5.0 Watts
Maximum Voltages and Current	2N3467	2N3468
V_{CBO} Collector to Base Voltage	−40 Volts	−50 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	−40 Volts	−50 Volts
V_{EBO} Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C Collector Current	1.0 Amp	1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N3467 Min.	2N3467 Max.	2N3468 Min.	2N3468 Max.	UNITS	TEST CONDITIONS
t_d	Turn On Delay Time (Figure 1)		10		10	ns	$I_C = 500$ mA $I_{B1} = 50$mA
t_r	Rise Time (Figure 1)		30		30	ns	$I_C = 500$ mA $I_{B1} = 50$mA
t_s	Storage Time (Figure 2)		60		60	ns	$I_C = 500$ mA $I_{B1} = I_{B2} = 50$ mA
t_f	Fall Time (Figure 2)		30		30	ns	$I_C = 500$ mA $I_{B1} = I_{B2} = 50$ mA
C_{ob}	Output Capacitance (f = 100 kHz)		25		25	pF	$I_E = 0$ $V_{CB} = -10$ V
C_{ib}	Input Capacitance (f = 100 kHz)		100		100	pF	$I_C = 0$ $V_{OB} = -0.5$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.75		1.5			$I_C = 50$ mA $V_{CE} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	−40		−50		Volts	$I_C = 10\ \mu A$ $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		−5.0		Volts	$I_E = 10\ \mu A$ $I_C = 0$
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	−40		−50		Volts	$I_C = 10$ mA $I_B = 0$
h_{FE}	DC Pulse Current Gain (Note 5)	40		25			$I_C = 150$ mA $V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	25	75		$I_C = 500$ mA $V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	40		20			$I_C = 1.0$ A $V_{CE} = -5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.30		−0.35	Volt	$I_C = 150$ mA $I_B = 15$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.50		−0.60	Volt	$I_C = 500$ mA $I_B = 50$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−1.0		−1.2	Volts	$I_C = 1.0$ A $I_B = 100$ mA

NOTES:

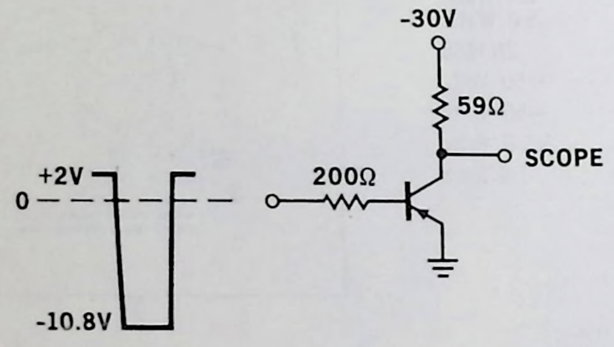
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/Watt (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C).
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N3467 Min.	2N3467 Max.	2N3468 Min.	2N3468 Max.	UNITS	TEST CONDITIONS
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−1.0		−1.0	Volt	$I_C = 150$ mA $I_B = 15$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)	−0.8	−1.2	−0.8	−1.2	Volts	$I_C = 500$ mA $I_B = 50$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−1.6		−1.6	Volts	$I_C = 1.0$ A $I_B = 100$ mA
I_{CBO}	Collector Cutoff Current		100		100	nA	$V_{CB} = -30$ V $I_E = 0$
$I_{CBO(100°C)}$	Collector Cutoff Current		15		15	μA	$V_{CB} = -30$ V $I_E = 0$
I_{CEX}	Collector Cutoff Current		100		100	nA	$V_{CB} = -30$ V $V_{OB} = -3.0$ V
I_{BL}	Base Cutoff Current		120		120	nA	$V_{CB} = -30$ V $V_{OB} = -3.0$ V
Q_T	Total Control Charge (Figure 3)		6.0		6.0	nC	$I_C = 500$ mA $I_B = 50$ mA

FIGURE 1

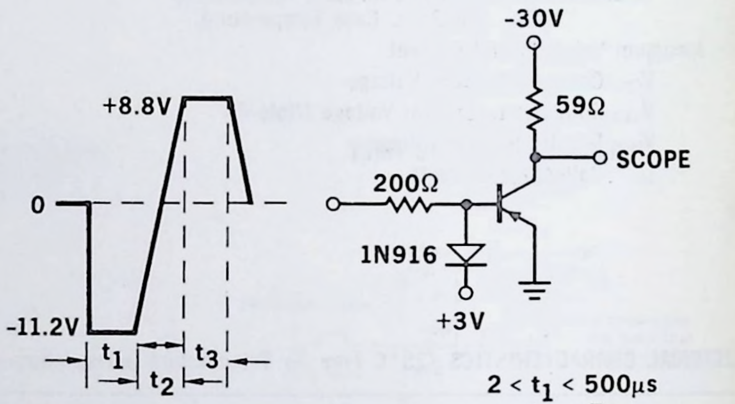
TURN-ON
EQUIVALENT TEST CIRCUIT


-30V
59Ω
SCOPE
+2V
0
200Ω
-10.8V

PW = 200ns
RISE TIME ≤ 2ns
DUTY CYCLE = 2%

FIGURE 2

TURN-OFF
EQUIVALENT TEST CIRCUIT

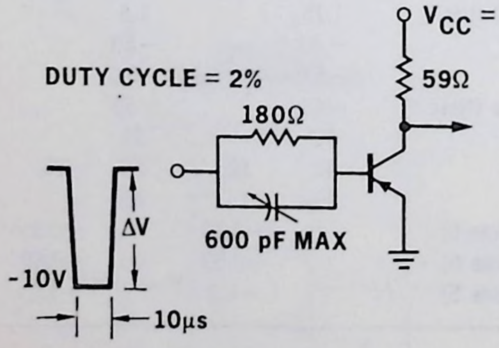

-30V
+8.8V
59Ω
SCOPE
0
200Ω
1N916
+3V
-11.2V
t1
t2
t3

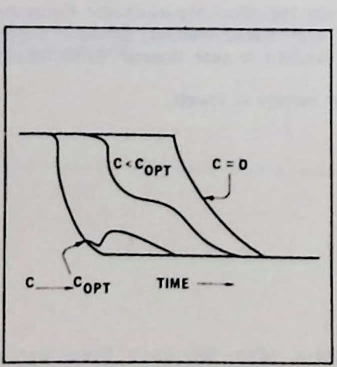
$2 < t_1 < 500\mu s$
$t_2 < 5ns$
$t_3 > 1\,\mu s$

DUTY CYCLE = 2%

FIGURE 3

Q_T TEST CIRCUIT


$V_{CC} = -30V$
DUTY CYCLE = 2%
59Ω
180Ω
ΔV
600 pF MAX
-10V
10μs

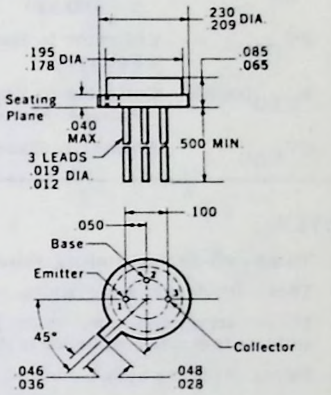


2N3485 · 2N3486 · 2N3485A · 2N3486A
PNP HIGH-SPEED SWITCHES AND CORE DRIVERS
SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3502 THROUGH 2N3505

GENERAL DESCRIPTION – These PNP Silicon Planar Epitaxial Transistors are designed primarily for high-speed saturated switching and core driver applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum

Maximum Power Dissipation

			2N3485 2N3486 2N3485A 2N3486A
Total Dissipation	at 25°C Case Temperature	(Notes 2 and 3)	2.0 Watts
	at 25°C Free Air Temperature	(Notes 2 and 3)	0.4 Watt

Maximum Voltages and Current

			2N3485 2N3486	2N3485A 2N3486A
V_{CBO}	Collector to Base Voltage		-60 Volts	-60 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-40 Volts	-60 Volts
V_{EBO}	Emitter to Base Voltage		-5.0 Volts	-5.0 Volts
I_C	Collector Current	(Note 2)	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3485		2N3485A		2N3486		2N3486A				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	40	120	100	300	100	300		I_C = 150 mA	V_{CE} = -10 V
h_{FE}	DC Current Gain	35		40		75		100			I_C = 10 mA	V_{CE} = -10 V
h_{FE}	DC Current Gain	25		40		50		100			I_C = 1.0 mA	V_{CE} = -10 V
h_{FE}	DC Current Gain	20		40		35		75			I_C = 0.1 mA	V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20		40		30		50			I_C = 500 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20		20		50		50			I_C = 150 mA	V_{CE} = -1.0 V
$V_{CE}(sat)$	Collector Saturation Voltage (pulsed, see Note 5)		-0.4		-0.4		-0.4		-0.4	Volts	I_C = 150 mA	I_B = 15 mA
$V_{CE}(sat)$	Collector Saturation Voltage (pulsed, see Note 5)		-1.6		-1.6		-1.6		-1.6	Volts	I_C = 500 mA	I_B = 50 mA
$V_{BE}(sat)$	Base Saturation Voltage (pulsed, see Note 1)		-1.3		-1.3		-1.3		-1.3	Volts	I_C = 150 mA	I_B = 15 mA
$V_{BE}(sat)$	Base Saturation Voltage (pulsed, see Note 1)		-2.6		-2.6		-2.6		-2.6	Volts	I_C = 500 mA	I_B = 50 mA
t_d	Turn-on Delay Time (see Fig. 1)		10		10		10		10	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_r	Rise Time (see Fig. 1)		40		40		40		40	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_s	Storage Time (see Fig. 2)		80		80		80		80	nsec	I_{CS} = 150 mA, $I_{B1} = I_{B2}$	= 15 mA
t_f	Fall Time (see Fig. 2)		30		30		30		30	nsec	I_{CS} = 150 mA, $I_{B1} = I_{B2}$	= 15 mA

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3485		2N3485A		2N3486		2N3486A				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions	
h_{fe}	High Frequency Current Gain (f = 100 Mc)	2.0		2.0		2.0		2.0			I_C = 50 mA	V_{CE} = -20 V
I_{CBO}	Collector Cutoff Current		20		10		20		10	nA	I_E = 0	V_{CB} = -50 V
I_{CBO}(150°C)	Collector Cutoff Current		20		10		20		10	μA	I_E = 0	V_{CB} = -50 V
I_{CEX}	Collector Reverse Current		50		50		50		50	nA	V_{CE} = -30 V	V_{BE} = +0.5 V
I_B	Base Current		50		50		50		50	nA	V_{CE} = -30 V	V_{BE} = +0.5 V
C_{obo}	Open Circuit Output Capacitance (f = 100 Kc)		8.0		8.0		8.0		8.0	pf	I_E = 0	V_{CB} = -10 V
C_{ibo}	Open Circuit Input Capacitance (f = 100 Kc)		30		30		30		30	pf	I_C = 0	V_{EB} = -2.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-60		-60		-60		Volts	I_C = 10 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-40		-60		-40		-60		Volts	I_C = 10 mA (pulsed)	I_C = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		-5.0		-5.0		Volts	I_E = 10 μA	I_C = 0

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 87.5°C/Watt (derating factor of 11.4 mW/°C); junction-to-ambient thermal resistance of 438°C/Watt (derating factor of 2.28 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

(5) Pulse Conditions: length ≤ 300 μsec; duty cycle ≤ 2%.

FIGURE 1

TEST CIRCUIT FOR DETERMINING DELAY TIME AND RISE TIME

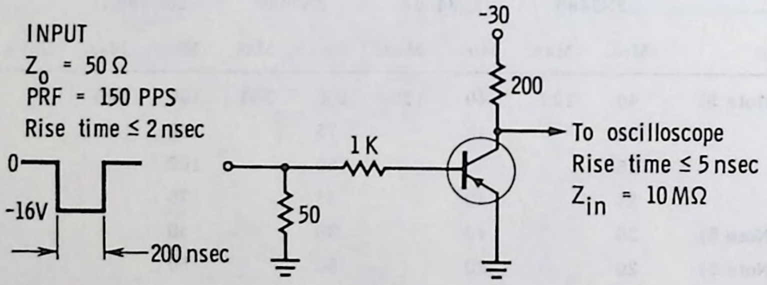
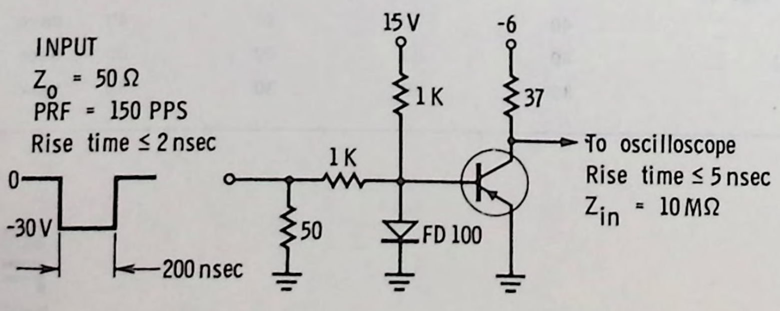

INPUT
Z_0 = 50 Ω
PRF = 150 PPS
Rise time ≤ 2 nsec
0
-16V
200 nsec
50
1 K
-30
200
To oscilloscope
Rise time ≤ 5 nsec
Z_{in} = 10 MΩ

FIGURE 2

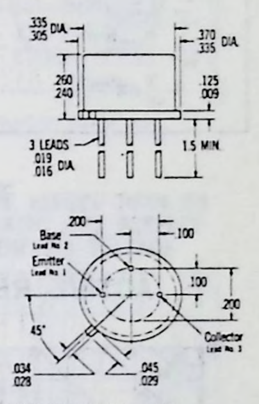
TEST CIRCUIT FOR DETERMINING STORAGE TIME AND FALL TIME


INPUT
Z_0 = 50 Ω
PRF = 150 PPS
Rise time ≤ 2 nsec
0
-30V
200 nsec
50
1 K
15V
1 K
FD 100
-6
37
To oscilloscope
Rise time ≤ 5 nsec
Z_{in} = 10 MΩ

2N3502 • 2N3503 • 2N3504 • 2N3505
PNP HIGH CURRENT SWITCHES
DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

ese PNP silicon PLANAR epitaxial transistors are designed for digital and analog applications at current els up to 500 milliamperes. Their high beta, high f_T at high current, high LV_{CEO}, and low noise figure ake them ideal for use as line drivers, memory applications and low-noise amplifiers.

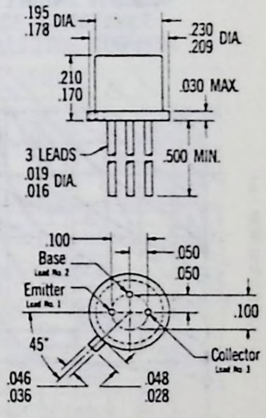
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N3502 • 2N3503

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N3504 • 2N3505

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum

Maximum Power Dissipation		2N3502 2N3503	2N3504 2N3505
Total Dissipation at 25°C Case Temperature	(Notes 2 & 3)	3.0 Watts	1.3 Watts
at 25°C Free Air Temperature	(Notes 2 & 3)	0.7 Watt	0.4 Watt

Maximum Voltages and Current		2N3503 2N3505	2N3502 2N3504
V_{CBO}	Collector to Base Voltage	-60 Volts	-45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-60 Volts	-45 Volts
V_{EBO}	Emitter to Base Voltage	-5.0 Volts	-5.0 Volts
I_C	Collector Current (Note 2)	600 mA	600 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

			2N3503 2N3505			2N3502 2N3504			
Symbol	Characteristic	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	Conditions
h_{FE}	DC Current Gain	80	120		80	120			I_C = 10 μA V_{CE} = -10 V
h_{FE}	DC Current Gain	120			120				I_C = 100 μA V_{CE} = -10 V
h_{FE}	DC Current Gain	135	200		135	200			I_C = 1.0 mA V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	140	270		140	270			I_C = 10 mA V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	100	150	300	100	150	300		I_C = 150 mA V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	50	70		50	70			I_C = 500 mA V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain	115	160	300	115	160	300		I_C = 50 mA V_{CE} = -1.0 V
$V_{BE}(sat)$	Base Saturation Voltage (Pulsed, see Note 1)		-0.9	-1.0		-0.9	-1.0	Volts	I_C = 50 mA I_B = 2.5 mA
$V_{BE}(sat)$	Base Saturation Voltage (Pulsed, see Note 1)		-1.0	-1.3		-1.0	-1.3	Volts	I_C = 150 mA I_B = 15 mA
$V_{CE}(sat)$	Collector Saturation Voltage (Pulsed, see Note 1)		-0.08	-0.25		-0.08	-0.25	Volts	I_C = 50 mA I_B = 2.5 mA
$V_{CE}(sat)$	Collector Saturation Voltage (Pulsed, see Note 1)		-0.18	-0.4		-0.18	-0.4	Volts	I_C = 150 mA I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	2.0	2.50		2.0	2.50			I_C = 50 mA V_{CE} = -20 V
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-60			-45			Volts	I_C = 10 mA (pulsed) I_B = 0
t_{on}	Turn On Time (Note 6)		20	40		20	40	nsec	I_C ≈ 300 mA I_{B1} ≈ 30 mA
t_{off}	Turn Off Time (Note 6)		40	100		40	100	nsec	I_C ≈ 300 mA, I_{B1} ≈ 30 mA I_{B2} ≈ -30 mA

FAIRCHILD
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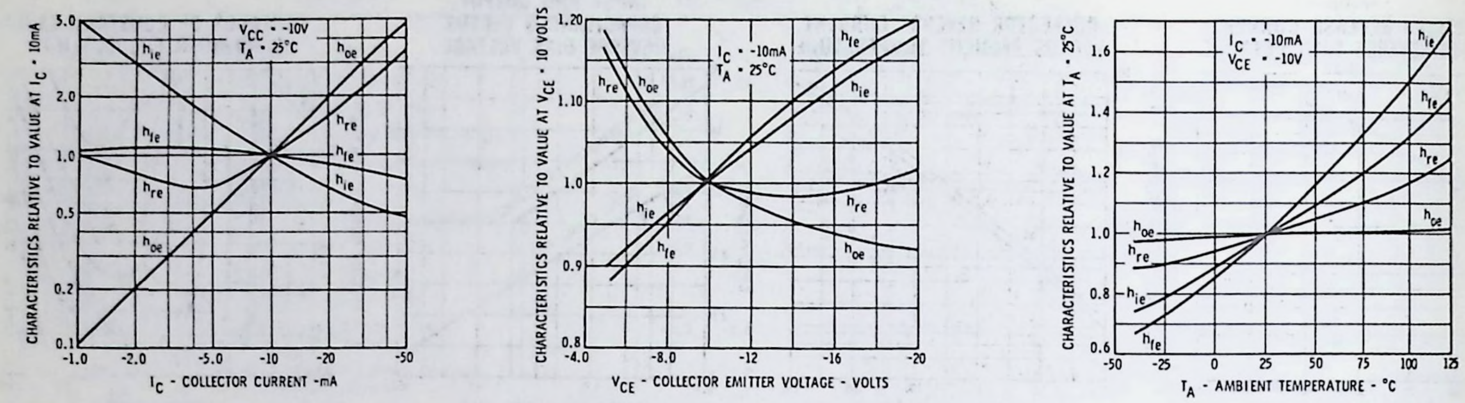
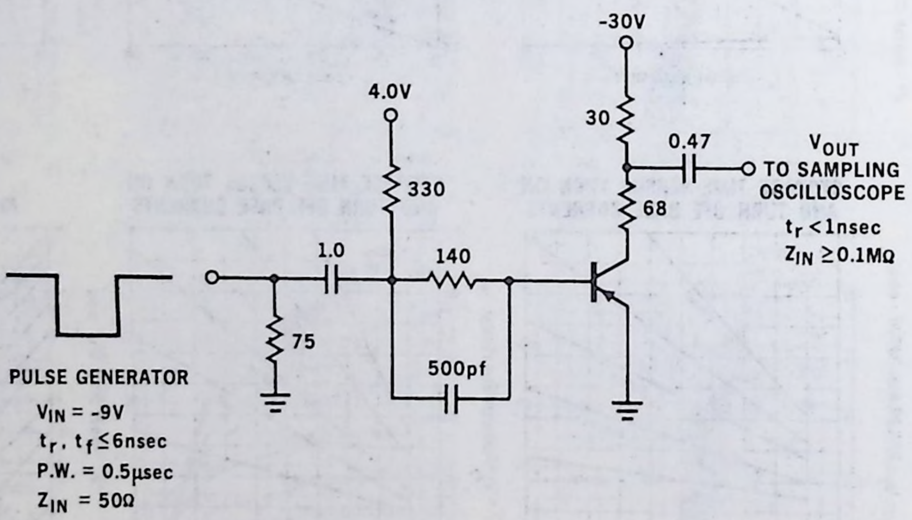
SMALL SIGNAL CHARACTERISTICS



(f = 1kc)

Symbol	Characteristics	Min.	Typ.	Max.	Units	Test Conditions
h_{ie}	Input Resistance		1050	2300	Ohms	I_C = 10 mA V_{CE} = -10 V
h_{oe}	Output Conductance		110	800	μmhos	I_C = 10 mA V_{CE} = -10 V
h_{re}	Voltage Feedback Ratio		240	1500	$\times 10^{-6}$	I_C = 10 mA V_{CE} = -10 V
h_{fe}	Small Signal Current Gain	135	200	420		I_C = 10 mA V_{CE} = -10 V

T_{ON} and T_{OFF} TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW for the 2N3502 and 2N3503, and 146°C/Watt (derating factor of 6.85 mW/°C) for the 2N3504 and 2N3505; junction-to-ambient thermal resist of 250°C/Watt (derating factor of 4.0 mW/°C) for the 2N3502 and 2N3503, and 438°C/Watt (derating factor of 2.28 mW/°C) for the 2N3504 and 2N3

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

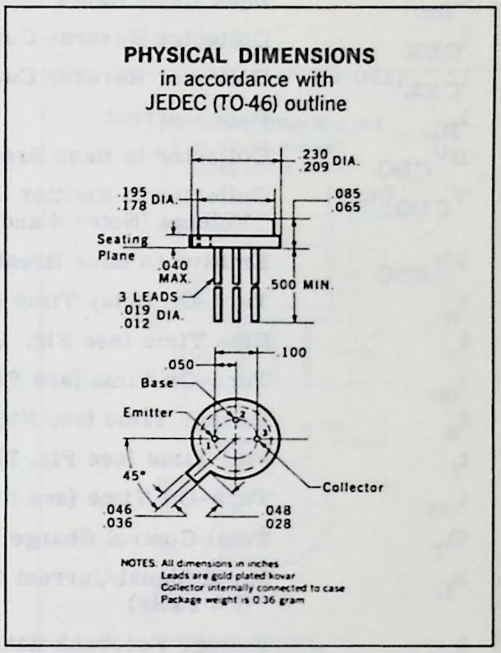
(7) f = 1.0 Kc; R_S = 10 KΩ.

2N3647 • 2N3648

NPN HIGH — SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

NERAL DESCRIPTION - The 2N3647 and 2N3648 are NPN diffused silicon Planar epitaxial nsistors designed primarily for high speed saturated switching and memory applications.


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline

NOTES. All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

SOLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 10 sec time limit)	240°C Maximum

aximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	2.0 Watts
at 25°C Ambient Temperature	0.4 Watts

aximum Voltages and Current

		2N3647	2N3648
V_{CBO}	Collector to Base Voltage	40 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	10 Volts	15 Volts
V_{EBO}	Emitter to Base Voltage	6 Volts	6 Volts
I_C	Collector Current	500 mA	500 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

ymbol	Characteristic	2N3647 Min.	2N3647 Max.	2N3648 Min.	2N3648 Max.	Units	Test Conditions
$_{FE}$	DC Pulse Current Gain (Note 5)	25	150	30	120		I_C = 150 mA V_{CE} = 1.0 V
$_{FE}$	DC Pulse Current Gain (Note 5)	20		25			I_C = 10 mA V_{CE} = 1.0 V
$_{FE}$	DC Current Gain	12		15			I_C = 1.0 mA V_{CE} = 1.0 V
$_{FE}$	DC Pulse Current Gain (Note 5)	15					I_C = 300 mA V_{CE} = 1.0 V
$_{FE}$	DC Pulse Current Gain (Note 5)			12			I_C = 500 mA V_{CE} = 1.0 V
$_{FE}^{(-55°C)}$	DC Pulse Current Gain (Note 5)			12			I_C = 150 mA V_{CE} = 1.0 V
$_{CE}^{(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.25		0.25	Volts	I_C = 10 mA I_B = 1.0 mA
$_{CE}^{(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.4		0.4	Volts	I_C = 150 mA I_B = 15 mA
$_{CE}^{(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.6			Volts	I_C = 300 mA I_B = 30 mA
$_{CE}^{(sat)}$	Pulsed Collector Saturation Voltage (Note 5)				0.8	Volts	I_C = 500 mA I_B = 50 mA
$_{BE}^{(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.8		0.8	Volts	I_C = 10 mA I_B = 1.0 mA
$_{BE}^{(sat)}$	Pulsed Base Saturation Voltage (Note 5)	0.8	1.0	0.8	1.0	Volts	I_C = 150 mA I_B = 15 mA
$_{BE}^{(sat)}$	Pulsed Base Saturation Voltage (Note 5)		1.15			Volts	I_C = 300 mA I_B = 30 mA
$_{BE}^{(sat)}$	Pulsed Base Saturation Voltage (Note 5)				1.5	Volts	I_C = 500 mA I_B = 50 mA

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3647 Min.	2N3647 Max.	2N3648 Min.	2N3648 Max.	Units	Test Conditions	
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.5		4.5			I_C = 15 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance		4.0		4.0	pf	I_E = 0	V_{CB} = 10 V
C_{ibo}	Input Capacitance		8.0		8.0	pf	I_C = 0	V_{EB} = 0.5 V
I_{CEX}	Collector Reverse Current		25		25	nA	V_{CE} = 10 V	V_{EB} = 1.0 V
I_{CEX}(150°C)	Collector Reverse Current		50		50	µA	V_{CE} = 10 V	V_{EB} = 1.0 V
I_{BL}	Base Current		25		25	nA	V_{CE} = 10 V	V_{EB} = 1.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	40		40		Volts	I_C = 10 µA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	10		15		Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	I_C = 0	I_E = 10 µA
t_d	Turn-On Delay Time (see Fig. 1)		10		8.0	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_r	Rise Time (see Fig. 1)		12		10	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_{on}	Turn-On Time (see Fig. 1)		20		16	nsec	I_{CS} = 150 mA	I_{B1} = 15 mA
t_s	Storage Time (see Fig. 2)		16		12	nsec	I_{CS} = 150 mA, I_{B1} = 15 mA,	I_{B2} = -15
t_f	Fall Time (see Fig. 2)		12		8.0	nsec	I_{CS} = 150 mA, I_{B1} = 15 mA,	I_{B2} = -15
t_{off}	Turn-Off Time (see Fig. 2)		25		18	nsec	I_{CS} = 150 mA, I_{B1} = 15 mA,	I_{B2} = -15
Q_T	Total Control Charge		0.3		0.3	ncoul	I_C = 150 mA	I_{B1} = 15 mA
h_{fe}	Small Signal Current Gain (f = 1 kHz)	20	150	20	150		I_C = 1.0 mA	V_{CE} = 10 V
h_{re}	Voltage Feedback Ratio (f = 1 kHz)		25		25	$x10^{-4}$	I_C = 1.0 mA	V_{CE} = 10 V
h_{ie}	Input Impedance (f = 1 kHz)	0.6	4.5	0.6	4.5	KΩ	I_C = 1.0 mA	V_{CE} = 10 V
h_{oe}	Output Admittance (f = 1 kHz)	10	100	10	100	µmho	I_C = 1.0 mA	V_{CE} = 10 V

SWITCHING TIME EQUIVALENT TEST CIRCUITS

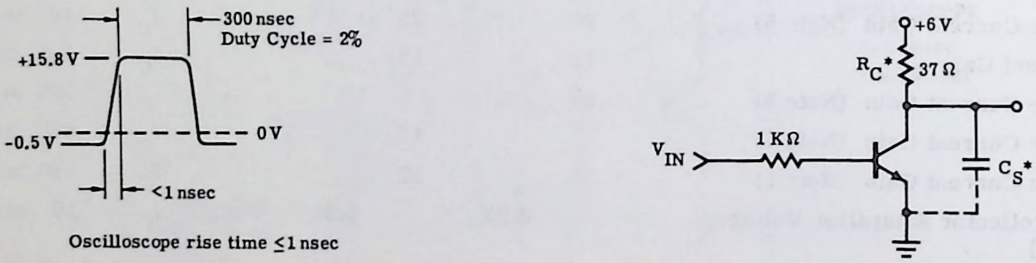


FIGURE 1 DELAY AND RISE TIME

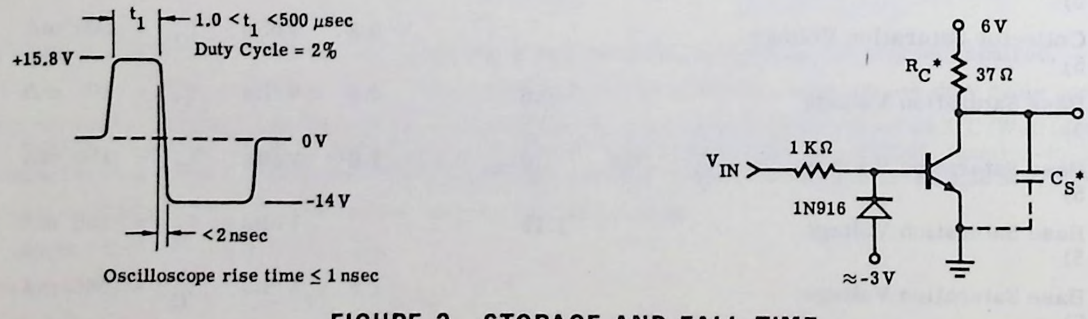


FIGURE 2 STORAGE AND FALL TIME

*C_S is total shunt capacitance of oscilloscope and test fixture.

*R_C includes oscilloscope resistance.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 87.5°C/watt (derating factor of 11.43 mW/°C); junction to ambient thermal resistance of 437°C/watt (derating factor of 2.29 mW/°C).

(4) Rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 µsec; duty cycle ≤2%.

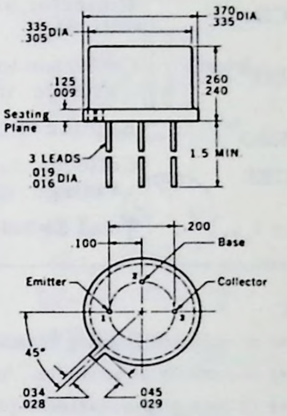
2N3665 • 2N3666

NPN GENERAL PURPOSE AMPLIFIER AND SWITCH

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

NERAL DESCRIPTION - The 2N3665 and 2N3666 are NPN Diffused Silicon Planar Epitaxial ansistors designed primarily for general purpose amplifier and switching applications. They ture high voltage, low output capacity and a useful beta over a wide current range.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

SOLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 10 sec. time limit)	300°C Maximum

aximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	5.0 Watts

aximum Voltages and Current

V_{CBO}	Collector to Base Voltage	120 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	80 Volts
V_{EBO}	Emitter to Base Voltage	10 Volts
I_C	Collector Current	1.0 Amp

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3665 Min.	2N3665 Max.	2N3666 Min.	2N3666 Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	100	300		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	30		70			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	25		50			I_C = 500 mA V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	16		40			I_C = 150 mA V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.8		1.8	Volts	I_C = 500 mA I_B = 50 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.2		1.2	Volts	I_C = 150 mA I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		1.2		1.2	Volts	I_C = 500 mA I_B = 50 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.5		0.5	Volts	I_C = 150 mA I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0		3.0			I_C = 50 mA V_{CE} = 10 V
C_{obo}	Open Circuit Output Capacitance		12		12	pf	I_E = 0 V_{CB} = 10 V
C_{ibo}	Open Circuit Input Capacitance		60		60	pf	I_C = 0 V_{EB} = 0.5 V

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3665 Min.	2N3665 Max.	2N3666 Min.	2N3666 Max.	Units	Test Conditions	
I_{CEX}	Collector Reverse Current		50		50	nA	V_{CE} = 80 V	V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		50		50	nA	V_{CB} = 60 V	I_E = 0
I_{CBO}(150°C)	Collector Cutoff Current		50		50	μA	V_{CB} = 60 V	I_E = 0
I_{BEX}	Base Reverse Current		50		50	nA	V_{CE} = 80 V	V_{EB} = 0.5 V
I_{EBO}	Emitter Cutoff Current		50		50	nA	I_C = 0	V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	120		120		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	80		80		Volts	I_C = 10 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	10		10		Volts	I_C = 0	I_E = 100 μA
BV_{CER}	Collector to Emitter Breakdown Voltage (Notes 4 and 5)	90		90		Volts	I_C = 10 mA	R_{BE} = 10 Ω
$t_{on} + t_{off}$	Total Switching Time		4.0		5.0	μsec	(See Fig. 1)	

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

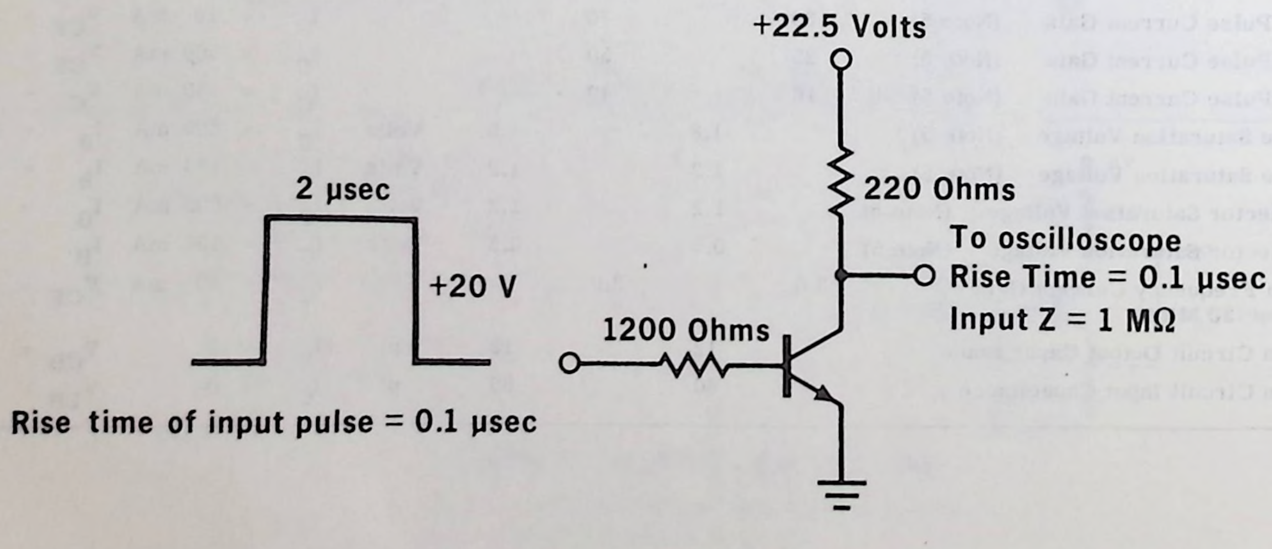
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/watt (derating factor of 28.6 mW/°C).

(4) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

SWITCHING CIRCUIT



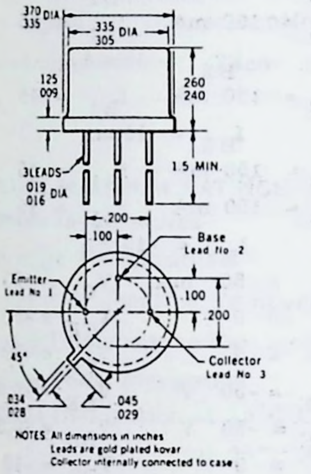
2N3671 · 2N3672 · 2N3673

PNP HIGH-SPEED SWITCHES AND CORE DRIVERS

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3502 • 2N3503

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline

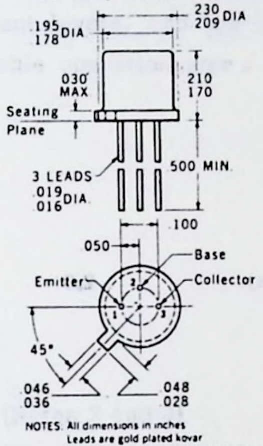


370
335 DIA
335
305 DIA
125
009
260
240
3LEADS
019
016 DIA
1.5 MIN.
.200
100
Base
Lead No 2
Emitter
Lead No 1
100
.200
45°
Collector
Lead No 3
034
028
.045
029

NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case.

2N3671

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline

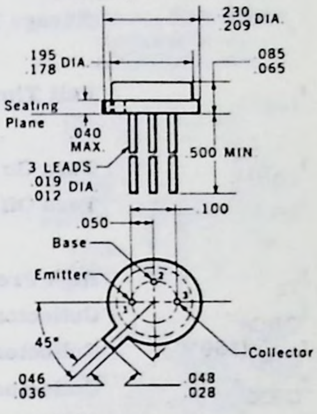


.230
.209 DIA
.195
.178 DIA
.030
MAX
.210
.170
Seating
Plane
3 LEADS
.019
.016 DIA
.500 MIN.
.100
.050
Base
Emitter
Collector
45°
.046
.036
.048
.028

NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N3672

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



.230
.209 DIA
.195
.178 DIA
.085
.065
Seating
Plane
.040
MAX.
3 LEADS
.019
.017 DIA
.500 MIN
.100
.050
Base
Emitter
45°
Collector
.046
.036
.048
.028

NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N3673

ENERAL DESCRIPTION - The 2N3671, 2N3672 and 2N3673 are PNP silicon Planar epitaxial transistors designed primarily for high-speed saturated witching, line drivers and memory applications.

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature			-65°C to +200°C
Operating Junction Temperature			200°C Maximum
Maximum Power Dissipation (Notes 2 and 3)	2N3671	2N3672	2N3673
Total Dissipation at 25°C Case Temperature	3.0 Watts	1.8 Watts	3.0 Watts
at 25°C Ambient Temperature	0.6 Watt	0.4 Watt	0.35 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		-60 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-50 Volts
V_{EBO}	Emitter to Base Voltage		-5.0 Volts
I_C	Collector Current	(Note 2)	600 mA

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic		Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain	(Note 5)	75	225		I_C = 150 mA V_{CE} = -10 V
h_{FE}	DC Current Gain		75			I_C = 1.0 mA V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain	(Note 5)	75			I_C = 10 mA V_{CE} = -10 V
h_{FE}	DC Current Gain		55			I_C = 0.1 mA V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain	(Note 5)	40			I_C = 500 mA V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain	(Note 5)	20			I_C = 150 mA V_{CE} = -0.6 V

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		-0.4	Volts	I_C = 150 mA I_B = 15 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		-1.6	Volts	I_C = 500 mA I_B = 50 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		-1.3	Volts	I_C = 150 mA I_B = 15 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		-2.6	Volts	I_C = 500 mA I_B = 50 mA
t_d	Turn-On Delay Time (See Figure 1)		10	ns	I_{CS} = 150 mA I_{B1} = 15 mA
t_r	Rise Time (See Figure 1)		40	ns	I_{CS} = 150 mA I_{B1} = 15 mA
t_s	Storage Time (See Figure 2)		80	ns	I_{CS} = 150 mA, I_{B1} = 15 mA, I_{B2} = -15 mA
t_f	Fall Time (See Figure 2)		30	ns	I_{CS} = 150 mA, I_{B1} = 15 mA, I_{B2} = -15 mA
t_{on}	Turn On Time (See Figure 1)		45	ns	I_{CS} = 150 mA I_{B1} = 15 mA
t_{off}	Turn Off Time (See Figure 2)		100	ns	I_{CS} = 150 mA I_{B1} = 15 mA I_{B2} = -15 mA
h_{fe}	High Frequency Current (f = 100 MHz)	2.0			I_C = 50 mA V_{CE} = -20 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0 V_{CB} = -50 V
I_{CBO}(150°C)	Collector Cutoff Current		10	μA	I_E = 0 V_{CB} = -50 V
I_{CEX}	Collector Reverse Current		50	nA	V_{CE} = -30 V V_{BE} = +0.5 V
I_B	Base Current		50	nA	V_{CE} = -30 V V_{BE} = +0.5 V
C_{obo}	Output Capacitance		9.0	pF	I_E = 0 V_{CB} = -10 V
C_{ibo}	Input Capacitance		30	pF	I_C = 0 V_{EB} = -2.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	-60		Volts	I_C = 10 μA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-50		Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		Volts	I_C = 0 I_E = 10 μ

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 58.3°C/watt (derating factor of 17.2 mW/°C); juncti ambient thermal resistance of 292°C/watt (derating factor of 3.43 mW/°C) for the 2N3671. Junction to case thermal resistance of 97.3°C/watt (derating fact 10.3 mW/°C) junction to ambient thermal resistance of 437°C/watt (derating factor of 2.28 mW/°C for the 2N3672. Junction to case thermal resistance of 58.3°C (derating factor of 17.2 mW/°C); junction to ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

FIGURE 1

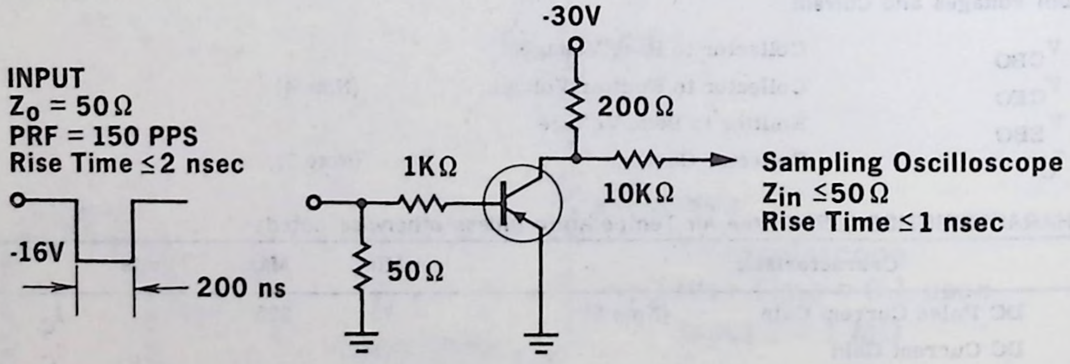
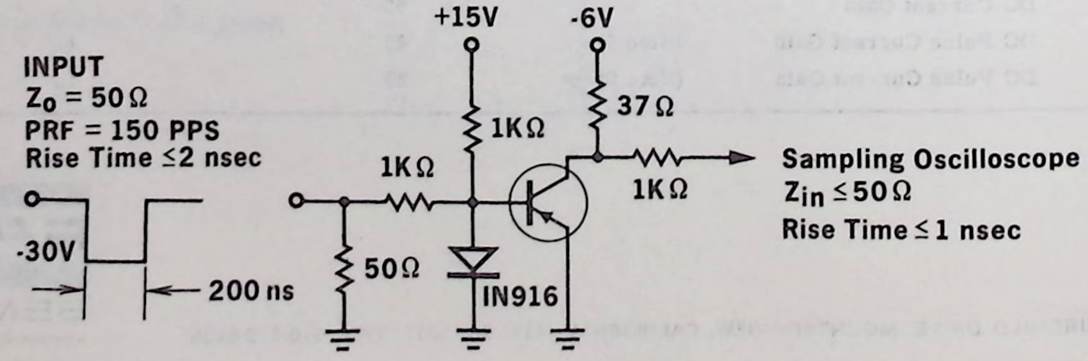


FIGURE 2



2N3678

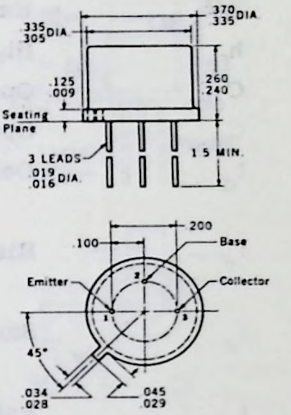
NPN HIGH SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3300

GENERAL DESCRIPTION - The 2N3678 NPN silicon Planar epitaxial transistor is designed for high current switching applications at levels to 800 milliamperes. It has excellent power dissipation capability, low saturation voltage at high current levels, and low leakage current at elevated temperature. These characteristics allow stable operation over a wide temperature range.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature		-65°C to +200°C
Operating Junction Temperature		+200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)		+230°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	4.0 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.8 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		75 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	55 Volts
V_{EBO}	Emitter to Base Voltage		6.0 Volts
I_C	Collector Current		800 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	40	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	35			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain	25			I_C = 1.0 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	25			I_C = 500 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain	20			I_C = 100 μA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	20			I_C = 150 mA	V_{CE} = 1.0 V
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 5)		0.4	Volts	I_C = 150 mA	I_B = 15 mA
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 5)		1.0	Volts	I_C = 500 mA	I_B = 50 mA
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 5)	0.6	1.2	Volts	I_C = 150 mA	I_B = 15 mA
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 5)		2.0	Volts	I_C = 500 mA	I_B = 50 mA
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 60 V
I_{CBO}(150°C)	Collector Cutoff Current		10	μA	I_E = 0	V_{CB} = 60 V

Additional Electrical Characteristics on page 2

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.8°C/watt (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 218.7°C/watt (derating factor of 4.57 mW/°C).

(4) This rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length $\leq$ 300 μsec; duty cycle $\leq$ 1%.

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
I_{CEX}	Collector Reverse Current		10	nA	$V_{CE} = 60$ V $\quad V_{EB} = 3.0$ V
I_{BL}	Base Current		20	nA	$V_{CE} = 60$ V $\quad V_{EB} = 3.0$ V
I_{EBO}	Emitter Cutoff Current		10	nA	$I_C = 0 \quad V_{EB} = 3.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	75		Volts	$I_C = 10\ \mu$A $\quad I_E = 0$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	55		Volts	$I_C = 10$ mA (pulsed) $\quad I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		Volts	$I_E = 10\ \mu$A $\quad I_C = 0$
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5			$I_C = 20$ mA $\quad V_{CE} = 20$ V
C_{obo}	Open Circuit Output Capacitance		8.0	pf	$I_E = 0 \quad V_{CB} = 10$ V
C_{ibo}	Open Circuit Input Capacitance		30	pf	$I_C = 0 \quad V_{EB} = 2.0$ V
t_d	Delay Time (see Fig. 1)		15	nsec	$V_{CC} = 30$ V $\quad I_{CS} = 150$ mA $I_{B1} = 15$ mA
t_r	Rise Time (see Fig. 1)		25	nsec	$V_{CC} = 30$ V $\quad I_{CS} = 150$ mA $I_{B1} = 15$ mA
t_s	Storage Time (see Fig. 2)		190	nsec	$V_{CC} = 6.0$ V $\quad I_{CS} = 150$ mA $I_{B1} = 15$ mA $\quad I_{B2} = -15$ mA
t_f	Fall Time (see Fig. 2)		60	nsec	$V_{CC} = 6.0$ V $\quad I_{CS} = 150$ mA $I_{B1} = 15$ mA $\quad I_{B2} = -15$ mA
$t_{on} + t_{off}$	Total Switching Time (see Fig. 3)		18	nsec	$V_{CC} = 30$ V $\quad R_L = 60\ \Omega$

FIGURE 1. Saturated turn-on switching-time test circuit

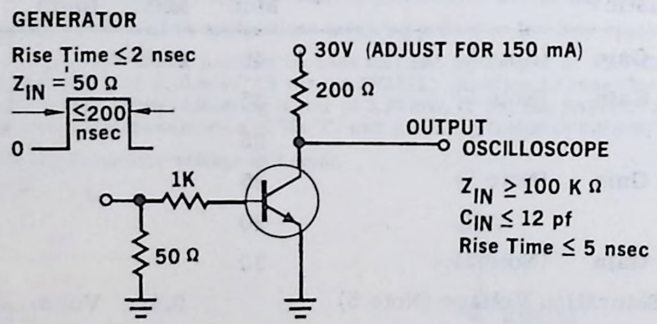

GENERATOR
Rise Time ≤ 2 nsec
Z_IN = 50 Ω
≤200 nsec
0
30V (ADJUST FOR 150 mA)
200 Ω
OUTPUT
OSCILLOSCOPE
Z_IN ≥ 100 K Ω
C_IN ≤ 12 pf
Rise Time ≤ 5 nsec
1K
50 Ω

FIGURE 2. Saturated turn-off switching-time test circuit

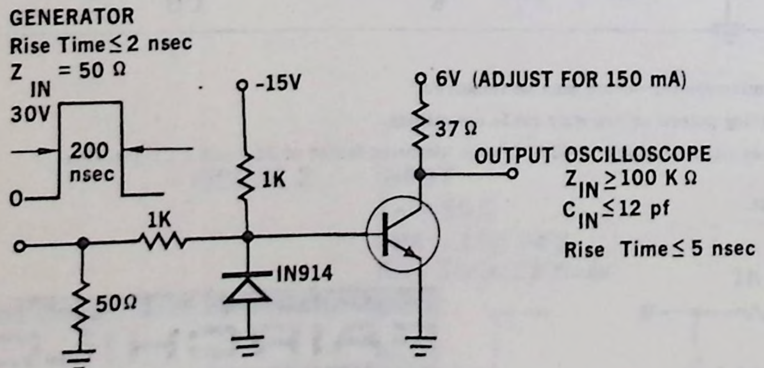
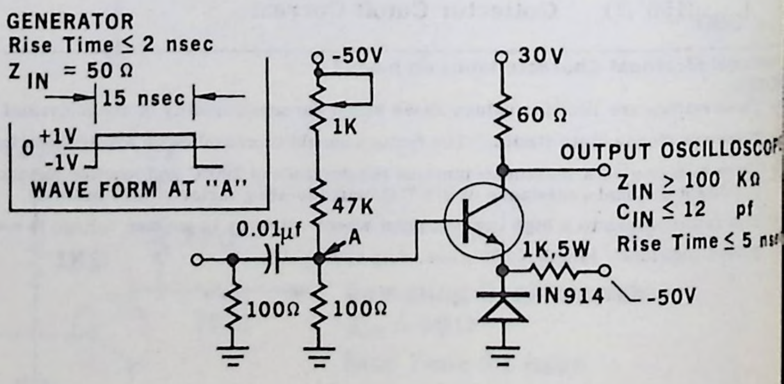

GENERATOR
Rise Time ≤ 2 nsec
Z_IN = 50 Ω
30V
200 nsec
0
-15V
6V (ADJUST FOR 150 mA)
37 Ω
OUTPUT OSCILLOSCOPE
Z_IN ≥ 100 K Ω
C_IN ≤ 12 pf
Rise Time ≤ 5 nsec
1K
1K
IN914
50Ω

FIGURE 3. Non-saturated switching-time test circuit


GENERATOR
Rise Time ≤ 2 nsec
Z_IN = 50 Ω
15 nsec
+1V
0
-1V
WAVE FORM AT "A"
-50V
1K
47K
0.01μf
A
100Ω
100Ω
30V
60 Ω
OUTPUT OSCILLOSCOP
Z_IN ≥ 100 KΩ
C_IN ≤ 12 pf
Rise Time ≤ 5 nse
1K,5W
IN914
-50V

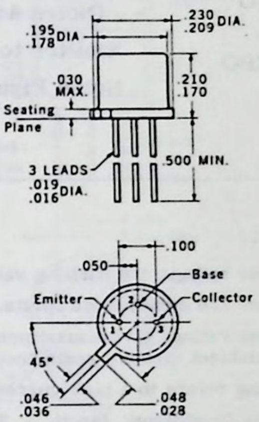
2N3700 • 2N3701

NPN HIGH FREQUENCY IF-RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The 2N3700 and 2N3701 are NPN diffused silicon Planar epitaxial transistors designed primarily for high frequency applications in IF-RF amplifier circuits. The Planar structure provides low saturation voltage at high collector currents and low leakage current over a wide range of temperature and bias conditions. Useful frequency range: DC to 1000 MHz.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)	300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.8 Watts
at 100°C Case Temperature	1.0 Watt
at 25°C Ambient Temperature	0.5 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		140 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	80 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts
I_C	Collector Current		1.0 Amp.

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3700 Min.	2N3700 Max.	2N3701 Min.	2N3701 Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	100	300	40	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	90		40	120		I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	50		30	100		I_C = 0.1 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	50		30	100		I_C = 500 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	15		15			I_C = 1.0 A	V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	40					I_C = 150 mA	V_{CE} = 10 V
V_{BE}(sat)	Pulsed Base Saturation Voltage		1.1		1.1	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.2		0.2	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.5		0.5	Volts	I_C = 500 mA	I_B = 50 mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	5.0	10	4.0	10		I_C = 50 mA	V_{CE} = 10 V
h_{fe}	Small Signal Current Gain (f = 1 KHz)	80	400	30	200		I_C = 1.0 mA	V_{CE} = 5.0 V
C_{obo}	Output Capacitance		12		12	pf	I_E = 0	V_{CB} = 10 V
C_{ibo}	Input Capacitance		60		60	pf	I_C = 0	V_{EB} = 0.5 V

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3700		2N3701			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions
$r_b'C_c$	Collector-Base Time Constant (f = 4 MHz)	25	400	25	400	psec	I_C = 10 mA V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current		10		10	nA	I_E = 0 V_{CB} = 90 V
I_{CBO}(150°C)	Collector Cutoff Current		10		10	μA	I_E = 0 V_{CB} = 90 V
I_{EBO}	Emitter Cutoff Current		10		10	nA	I_C = 0 V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	140		140		Volts	I_C = 100 μA I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	80		80		Volts	I_C = 30 mA I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		Volts	I_C = 0 I_E = 100 μA
NF	Noise Figure		4.0			db	I_C = 100 μA V_{CE} = 10 V f = 1 KHz R_G = 1 KΩ

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 97°C/watt (derating factor of 10.3 mW/°C); junction to ambient thermal resistance of 350°C/watt (derating factor of 2.85 mW/°C).

(4) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

(5) Pulse Conditions: length = 300 μsec; duty cycle ≤ 1%.

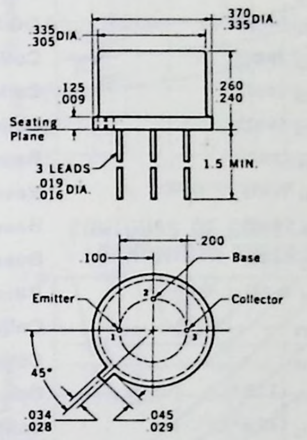
2N3722 · 2N3723

NPN HIGH-VOLTAGE, HIGH-CURRENT SWITCHES

SILICON PLANAR EPITAXIAL TRANSISTORS

HIGH BREAKDOWN -- 80 VOLT LV_{CEO}
HIGH FREQUENCY -- $f_T = 300$ MHz Min.
FAST HIGH CURRENT SWITCHING
LOW V_{CE} (sat) -- 0.75V Max. @ 500 mA
LOW OUTPUT CAPACITANCE -- 9.0 pF

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

SOLUTE MAXIMUM RATINGS (Note 1)

ximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)	+300°C Maximum

ximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	4.0 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.8 Watt

ximum Voltages and Current

		2N3722	2N3723
$_{CBO}$	Collector to Base Voltage	80 Volts	100 Volts
$_{CES}$	Collector to Emitter Voltage	80 Volts	100 Volts
$_{CEO}$	Collector to Emitter Voltage (Note 4)	60 Volts	80 Volts
$_{EBO}$	Emitter to Base Voltage	6.0 Volts	6.0 Volts
	Maximum Collector Current (Note 5)	1.0 Amp	1.0 Amp

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3722			2N3723					
Symbol	Characteristic	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	Test Conditions	
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60			80			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
V_{CE} (sat)	Collector Saturation Voltage (pulsed, see Note 5)		0.35	0.5		0.45	0.75	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{CE} (sat)	Collector Saturation Voltage (pulsed, see Note 5)		0.25	0.37		0.30	0.44	Volts	$I_C = 300$ mA	$I_B = 30$ mA
t_{on}	Turn-on Time (Note 6)		20	50		25	70	nsec	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA
t_{off}	Turn-off Time (Note 6)		63	100		70	130	nsec	$I_C \approx 500$ mA,	$I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA
h_{fe}	High Frequency Current Gain (f = 100 Mc)	3.0	4.0		3.0	4.0			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{obo}	Common-Base, Open-Circuit Output Capacitance		5.5	10		5.0	9.0	pf	$I_E = 0$	$V_{CB} = 10$ V
C_{ibo}	Common-Base, Open-Circuit Input Capacitance		50	65		50	65	pf	$I_C = 0$	$V_{BE} = -0.5$ V

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3722 Min.	2N3722 Typ.	2N3722 Max.	2N3723 Min.	2N3723 Typ.	2N3723 Max.	Units	Test Conditions	
*h_{FE}	DC Pulse Current Gain (Note 5)	40	70	150	**40**	**70**	**150**		I_C = 100 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	45		25	45			I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	20	35		**15**	**30**			I_C = 300 mA	V_{CE} = 2.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	15	30						I_C = 500 mA	V_{CE} = 2.0 V
h_{FE}	DC Pulse Current Gain (Note 5)				15	30			I_C = 500 mA	V_{CE} = 3.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	12	25		12	25			I_C = 800 mA	V_{CE} = 5.0 V
h_{FE} (−55°C)	DC Pulse Current Gain (Note 5)	15	30		15	30			I_C = 100 mA	V_{CE} = 1.0 V
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.15	0.22		0.22	0.28	Volts	I_C = 100 mA	I_B = 10 m
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.16	0.25		0.16	0.25	Volts	I_C = 10 mA	I_B = 1.0 m
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.6	2.0				Volts	I_C = 800 mA	I_B = 80 m
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.62	0.75		0.62	0.75	Volts	I_C = 10 mA	I_B = 1.0 m
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.73	0.85		0.73	0.85	Volts	I_C = 100 mA	I_B = 10 m
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.89	1.1		0.89	1.1	Volts	I_C = 300 mA	I_B = 30 m
V_{BE} (sat)	Base Saturation Voltage (Note 5)	0.86	0.91	1.2	0.86	0.91	1.2	Volts	I_C = 500 mA	I_B = 50 m
V_{BE} (sat)	Base Saturation Voltage (Note 5)		1.0	1.5				Volts	I_C = 800 mA	I_B = 80 m
I_{CES}	Collector Reverse Current		0.1	0.5				μA	V_{CE} = 40 V	V_{EB} = 0
I_{CES}	Collector Reverse Current					0.13	0.5	μA	V_{CE} = 50 V	V_{EB} = 0
I_{CES} (125°C)	Collector Reverse Current		40	70				μA	V_{CE} = 40 V	V_{EB} = 0
I_{CES} (125°C)	Collector Reverse Current					40	70	μA	V_{CE} = 50 V	V_{EB} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	80			100			Volts	I_C = 100 μA	I_E = 0
B_{CES}	Collector to Emitter Breakdown Voltage	80			100			Volts	I_C = 100 μA	V_{EB} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	I_C = 0	I_E = 100 μ
h_{FE} (−55°C)	DC Pulse Current Gain (Note 5)	20			**20**				I_C = 200 mA	V_{CE} = 2.0 V

TYPICAL ELECTRICAL CHARACTERISTICS

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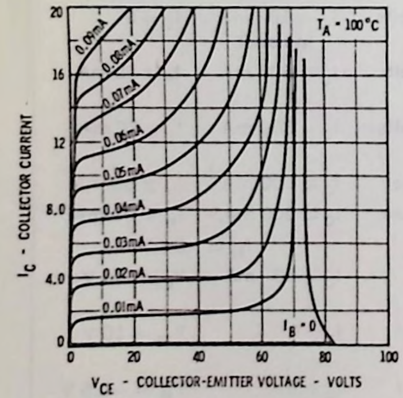
COLLECTOR CHARACTERISTICS



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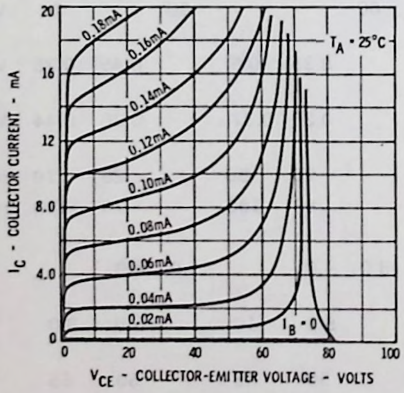

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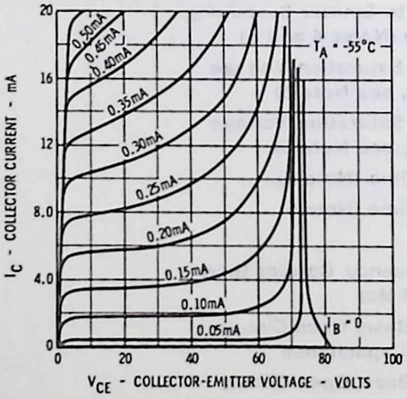
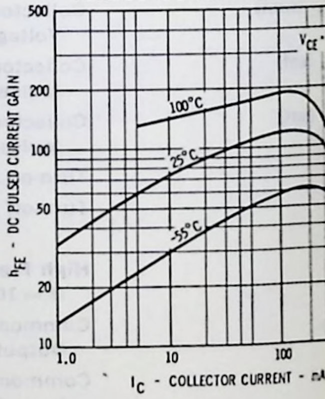


DC PULSED CURRENT GAI VERSUS COLLECTOR CURR



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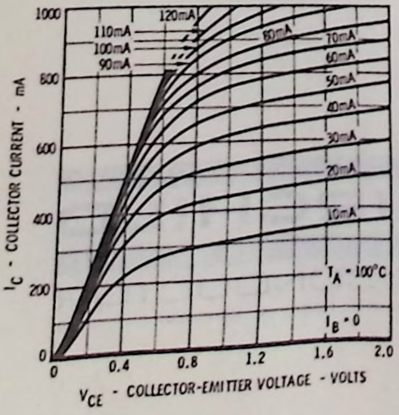

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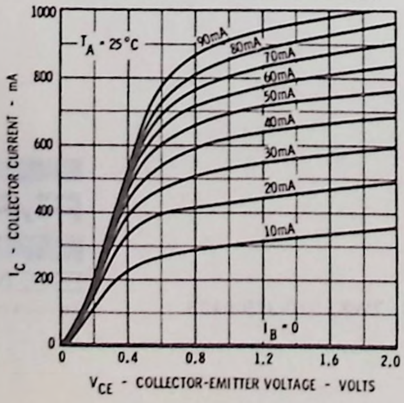
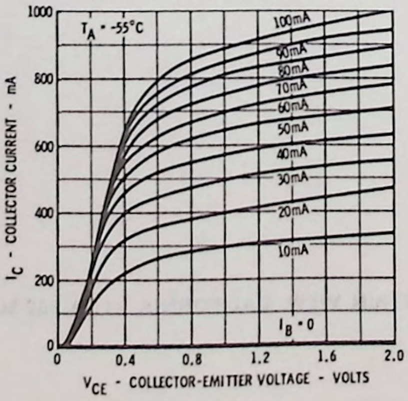
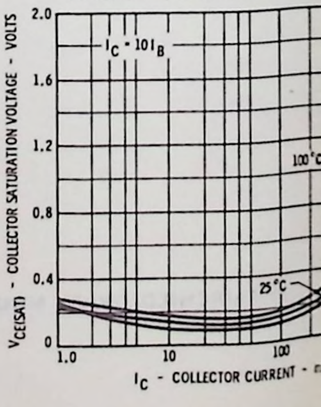


COLLECTOR CHARACTERISTICS



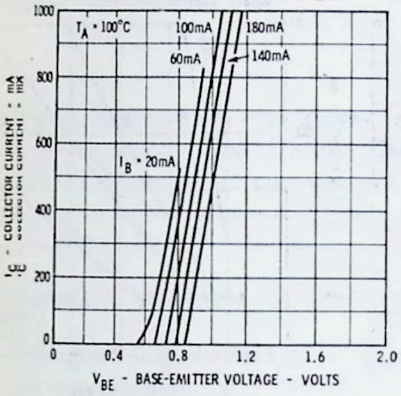
COLLECTOR SATURATION V VERSUS COLLECTOR CUR



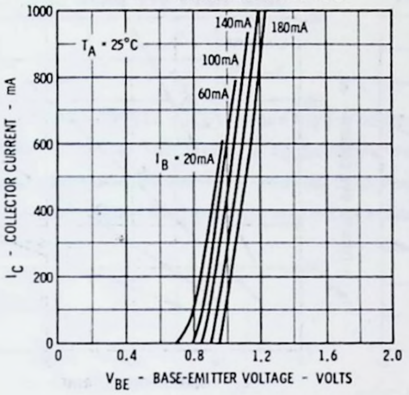
TYPICAL ELECTRICAL CHARACTERISTICS

2N3722 • 2N3723

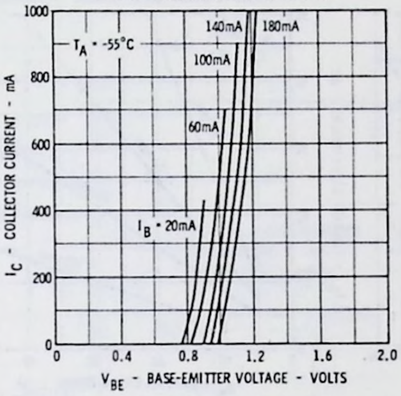
BASE CHARACTERISTICS



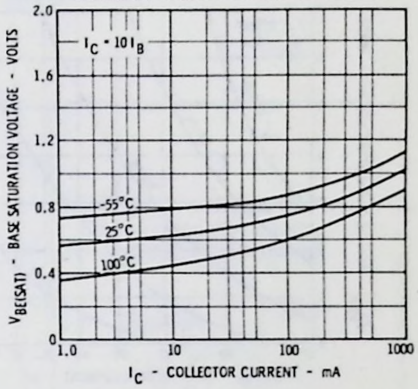
BASE CHARACTERISTICS



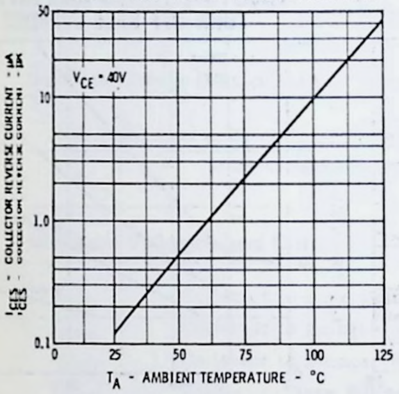
BASE CHARACTERISTICS



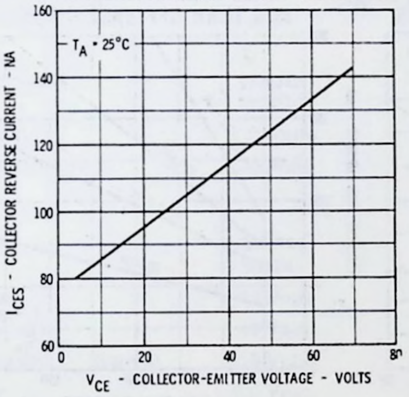
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



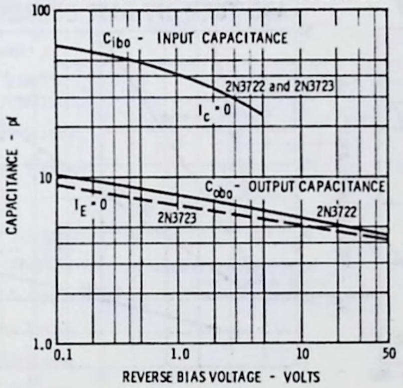
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



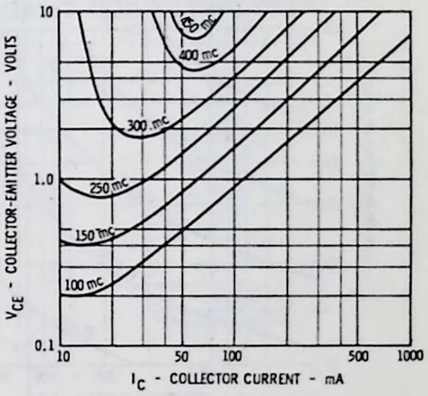
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



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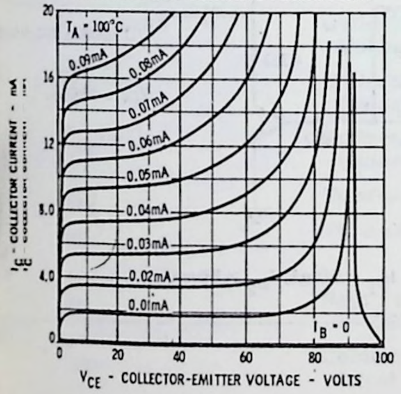
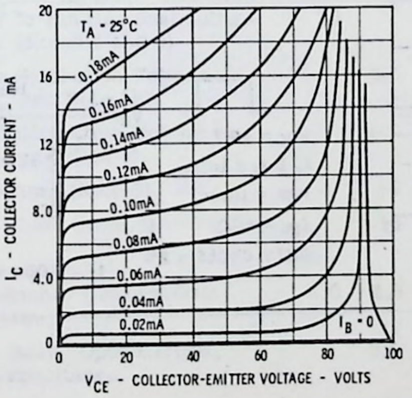
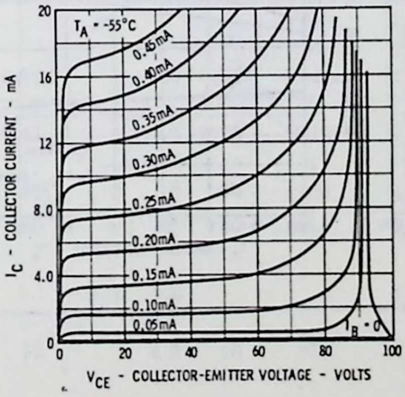
COLLECTOR CHARACTERISTICS



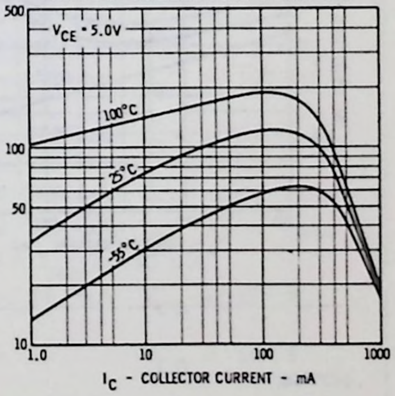
COLLECTOR CHARACTERISTICS



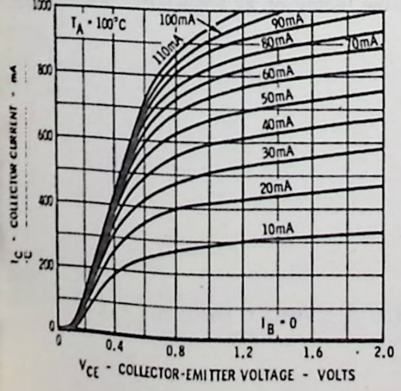
COLLECTOR CHARACTERISTICS



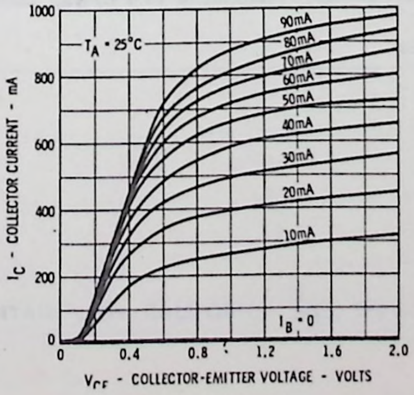
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



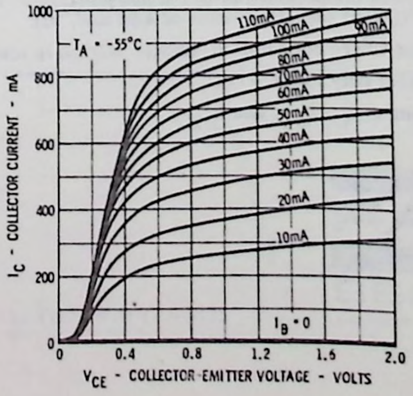
COLLECTOR CHARACTERISTICS



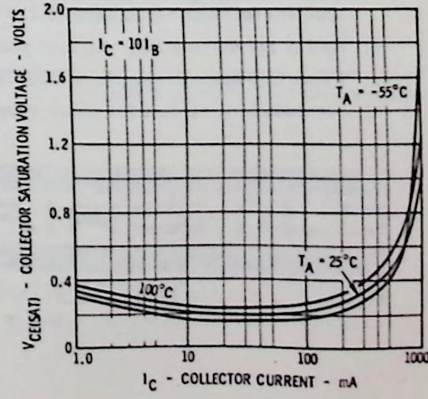
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS

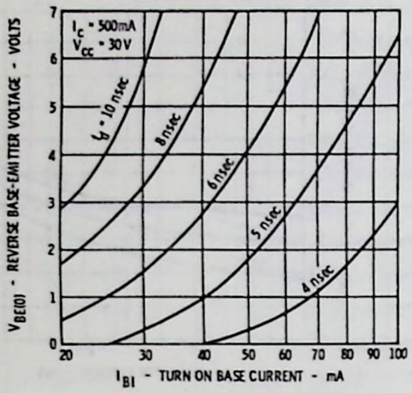


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

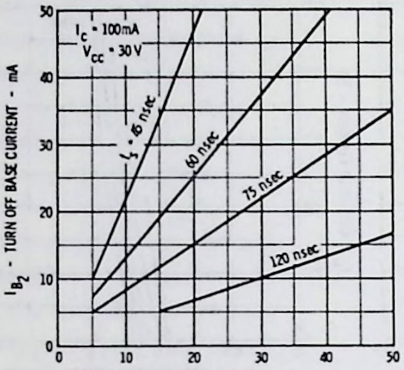


TYPICAL ELECTRICAL CHARACTERISTICS
2N3722 • 2N3723

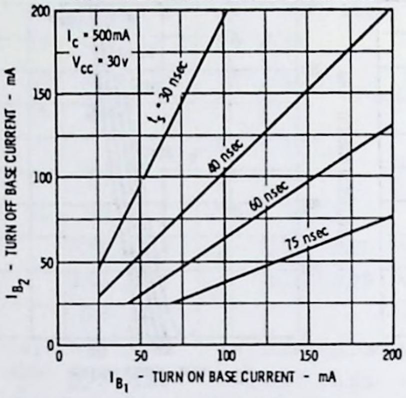
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



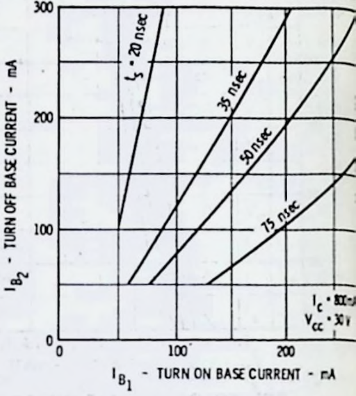
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



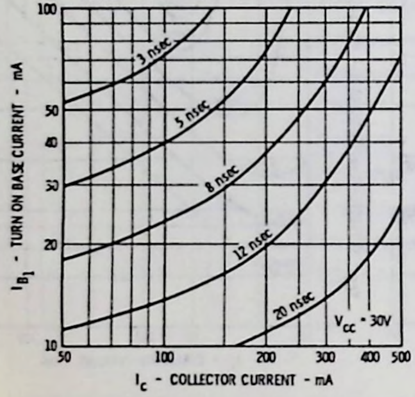
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



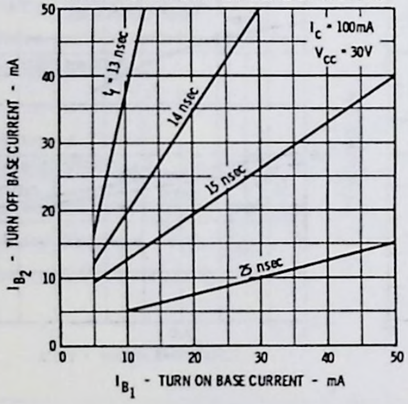
STORAGE TIME VERSUS TURN O AND TURN OFF BASE CURRENT



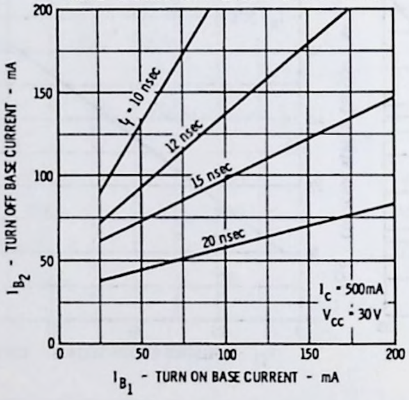
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



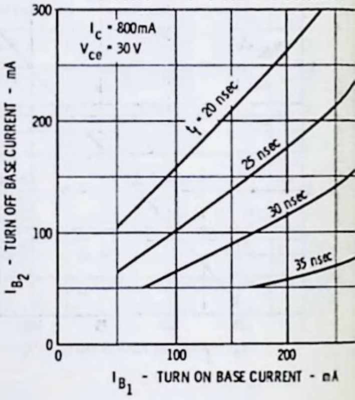
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



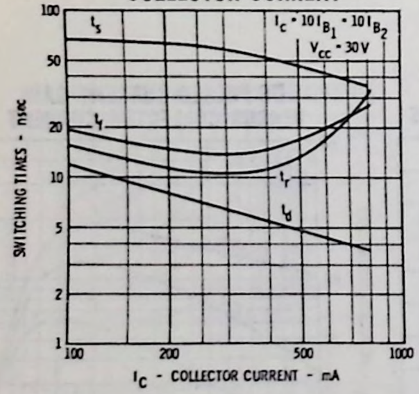
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



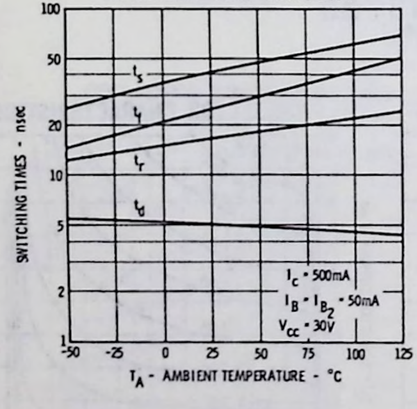
FALL TIME VERSUS TURN ON A TURN OFF BASE CURRENT



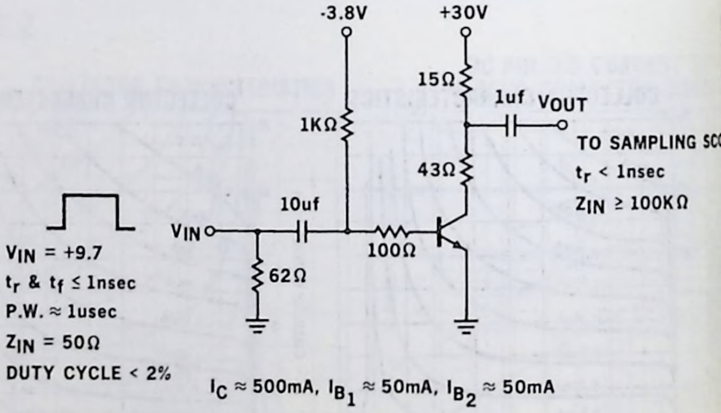
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



$I_C \approx 500mA$, $I_{B_1} \approx 50mA$, $I_{B_2} \approx 50mA$

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 43.8°C/Watt (derating factor of 22.8 mW/°C). Junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

2N3724 · 2N3725 · 2N4013 · 2N4014

NPN HIGH-VOLTAGE, HIGH-CURRENT SWITCHES

SILICON PLANAR* EPITAXIAL TRANSISTORS

ENERAL DESCRIPTION - The 2N3724 · 2N3725 and 2N4013 · 2N4014 are High-Voltage, High-urrent NPN Silicon Planar Epitaxial Transistors useful for memory applications requiring reakdown voltages up to 50 volts and operating currents to one ampere. Fast turn-on and turn-ff times are assured because of the high minimum f_T (300 MHz) and tight control on storage time.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	+300°C Maximum

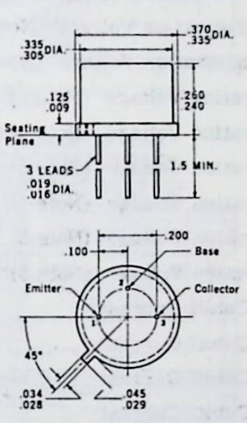
Maximum Power Dissipation (Notes 2 and 3)

	2N4013 2N4014	2N3724 2N3725
Total Dissipation at 25°C Case Temperature	1.2 Watts	3.5 Watts
at 25°C Ambient Temperature	0.36 Watt	0.8 Watt

Maximum Voltages and Current

			2N3724 2N4013	2N3725 2N4014
V_{CBO}	Collector to Base Voltage		50 Volts	80 Volts
V_{CES}	Collector to Emitter Voltage		50 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	30 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage		6.0 Volts	6.0 Volts
I_C	Maximum Collector Current	(Note 5)	1.0 Amp	1.0 Amp

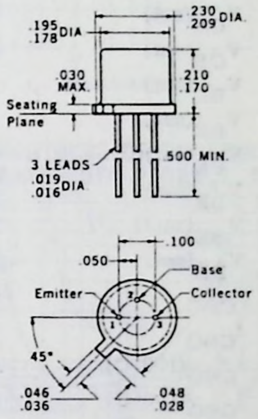
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

2N3724 · 2N3725

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.44 gram

2N4013 · 2N4014

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3724 2N4013			2N3725 2N4014				
Symbol	Characteristic	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	Test Conditions
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			50			Volts	I_C = 10 mA (pulsed) I_B = 0
V_{CE}(sat)	Collector Saturation Voltage (pulsed, see Note 5)		0.5	0.75		0.6	0.95	Volts	I_C = 1000 mA I_B = 100 mA
V_{CE}(sat)	Collector Saturation Voltage (pulsed, see Note 5)		0.3	0.42		0.4	0.52	Volts	I_C = 500 mA I_B = 50 mA
t_{on}	Turn-on Time (Note 6)		18	35		18	35	nsec	$I_C \approx$ 500 mA $I_{B1} \approx$ 50 mA
t_{off}	Turn-off Time (Note 6)		45	60		45	60	nsec	$I_C \approx$ 500 mA, $I_{B1} \approx$ 50 mA, $I_{B2} \approx$ -50 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	4.5		3.0	4.5			I_C = 50 mA V_{CE} = 10 V
C_{obo}	Common Base, Open Circuit, Output Capacitance		6.0	12		4.8	10	pF	I_E = 0 V_{CB} = 10 V
C_{ibo}	Common Base, Open Circuit, Input Capacitance		40	55		40	55	pF	I_C = 0 V_{BE} = 0.5 V

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* Planar is a patented Fairchild process.

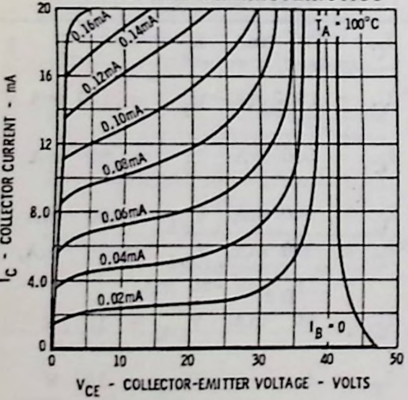
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

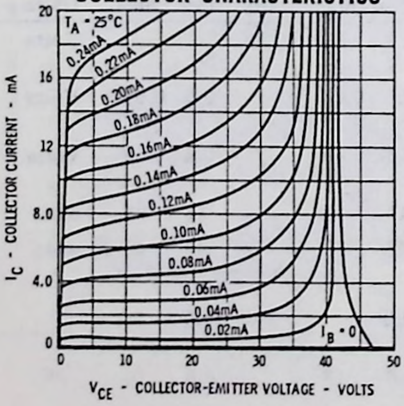
FAIRCHILD TRANSISTORS 2N3724 • 2N3725 • 2N4013 • 2N4014

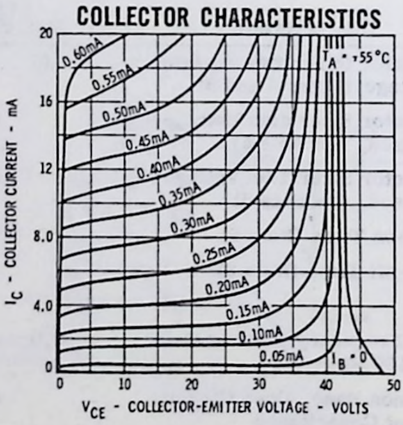
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

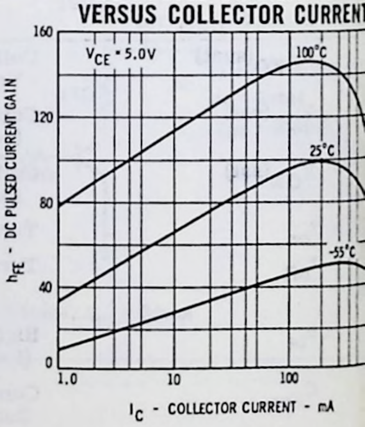
Symbol	Characteristic	2N3724 2N4013 Min.	2N3724 2N4013 Typ.	2N3724 2N4013 Max.	2N3725 2N4014 Min.	2N3725 2N4014 Typ.	2N3725 2N4014 Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	60	90	150	60	90	150		I_C = 100 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	35	50		35	45			I_C = 500 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	65		40	60			I_C = 300 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	65		25	65			I_C = 1000 mA V_{CE} = 5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60		30	60			I_C = 10 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	45		20	40			I_C = 800 mA V_{CE} = 2.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	30	45		30	40			I_C = 100 mA V_{CE} = 1.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	20	40		20	35			I_C = 500 mA V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.11	0.25		0.19	0.25	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.13	0.2		0.21	0.26	Volts	I_C = 100 mA I_B = 10 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.22	0.32		0.31	0.4	Volts	I_C = 300 mA I_B = 30 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.4	0.65		0.5	0.8	Volts	I_C = 800 mA I_B = 80 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.64	0.76		0.64	0.76	Volts	I_C = 10 mA I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.75	0.86		0.75	0.86	Volts	I_C = 100 mA I_B = 10 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.89	1.1		0.89	1.1	Volts	I_C = 300 mA I_B = 30 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)	0.9	0.95	1.2	0.9	0.95	1.2	Volts	I_C = 500 mA I_B = 50 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.0	1.5		1.0	1.5	Volts	I_C = 800 mA I_B = 80 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.1	1.7		1.1	1.7	Volts	I_C = 1000 mA I_B = 100 mA
I_{CBO}	Collector Cutoff Current		0.25	1.7				µA	I_E = 0 V_{CB} = 40 V
I_{CBO}	Collector Cutoff Current					0.33	1.7	µA	I_E = 0 V_{CB} = 60 V
I_{CBO}(100°C)	Collector Cutoff Current		25	120				µA	I_E = 0 V_{CB} = 40 V
I_{CBO}(100°C)	Collector Cutoff Current					25	120	µA	I_E = 0 V_{CB} = 60 V
BV_{CBO}	Collector to Base Breakdown Voltage	50			80			Volts	I_C = 10 µA I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	50			80			Volts	I_C = 10 µA V_{BE} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	I_C = 0 I_E = 10 µA

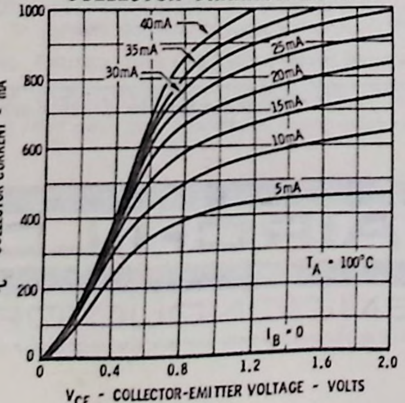
TYPICAL ELECTRICAL CHARACTERISTICS
2N3724 • 2N4013

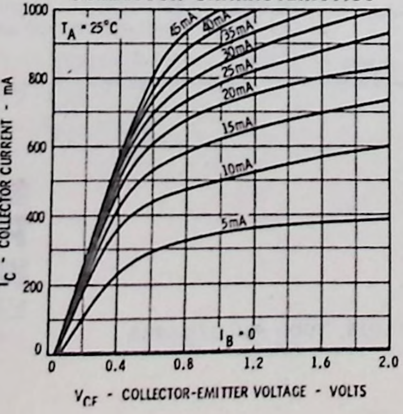

COLLECTOR CHARACTERISTICS

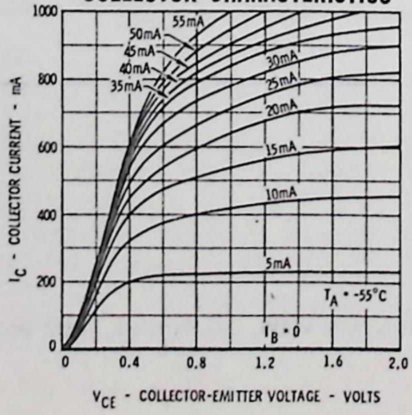

COLLECTOR CHARACTERISTICS


COLLECTOR CHARACTERISTICS


DC PULSED CURRENT GAIN
VERSUS COLLECTOR CURRENT


COLLECTOR CHARACTERISTICS


COLLECTOR CHARACTERISTICS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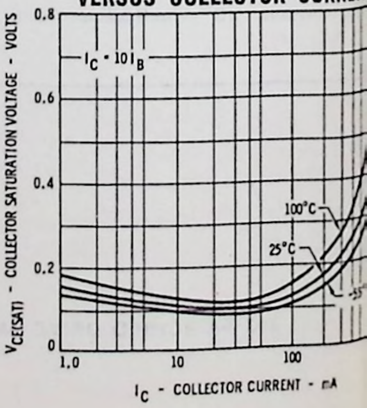
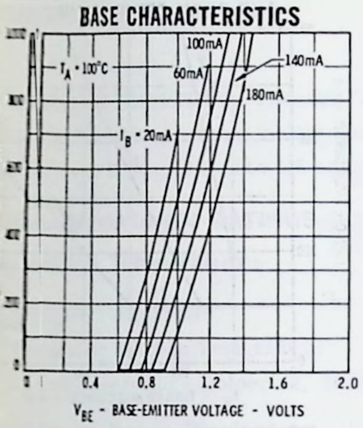

COLLECTOR SATURATION VOLTA
VERSUS COLLECTOR CURRENT

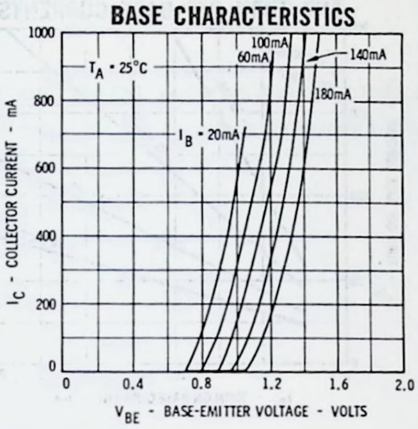
TYPICAL ELECTRICAL CHARACTERISTICS

2N3724 • 2N3725 • 2N4013 • 2N4014

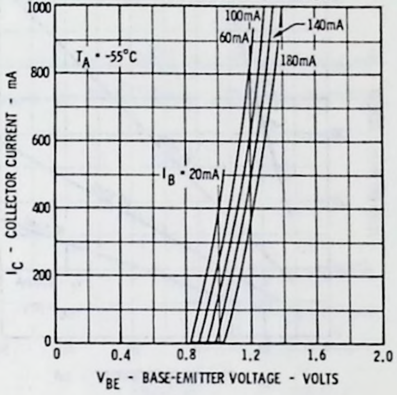
BASE CHARACTERISTICS



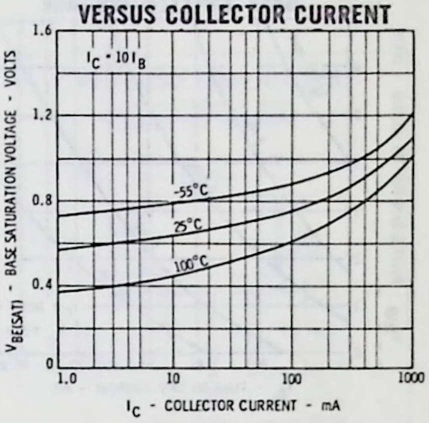
BASE CHARACTERISTICS



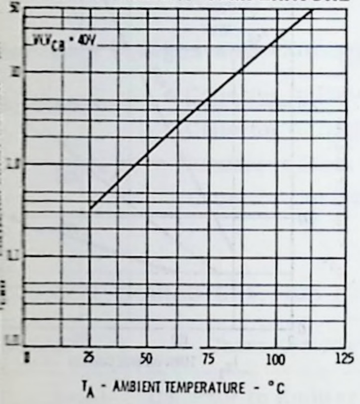
BASE CHARACTERISTICS



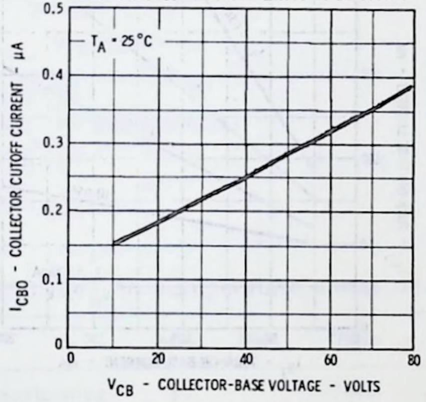
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



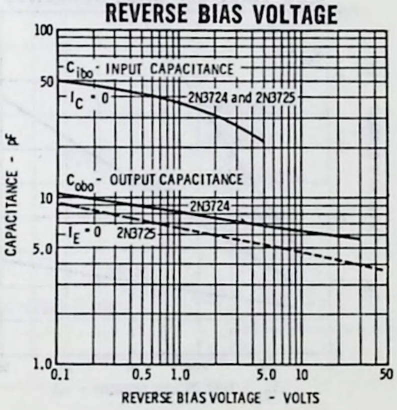
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



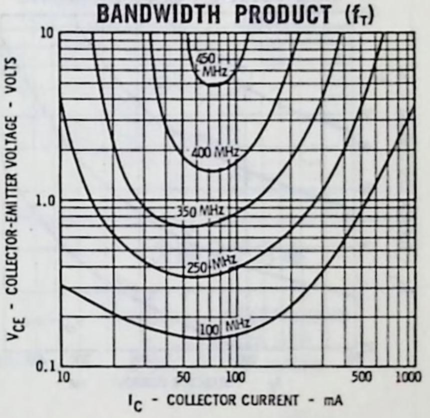
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

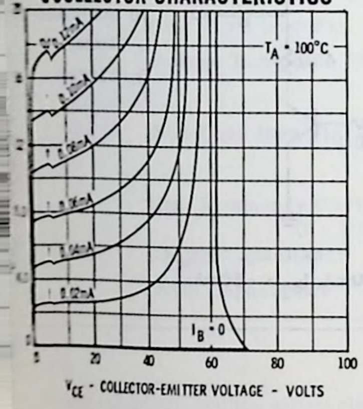


CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)

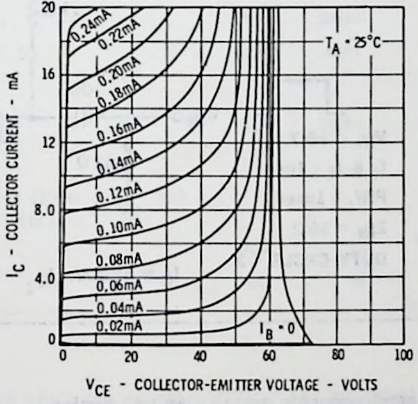


2N3725 • 2N4014

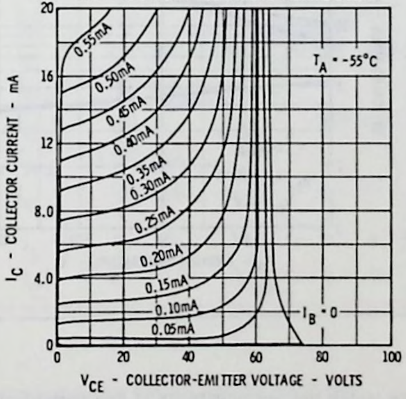
COLLECTOR CHARACTERISTICS



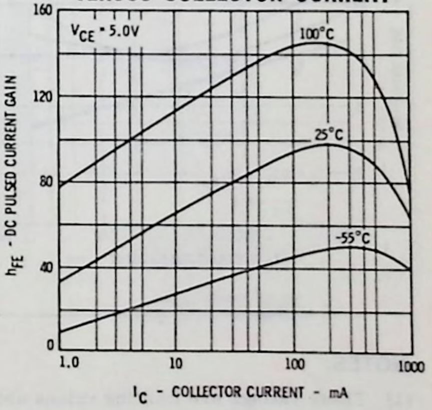
COLLECTOR CHARACTERISTICS



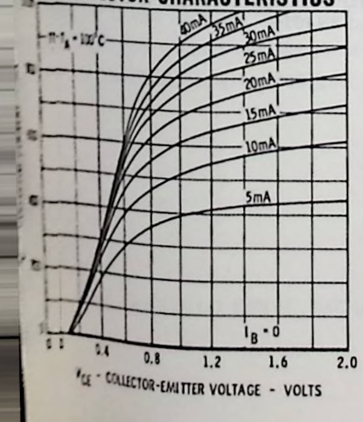
COLLECTOR CHARACTERISTICS



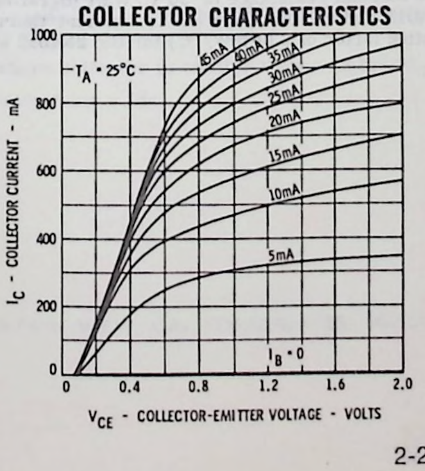
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



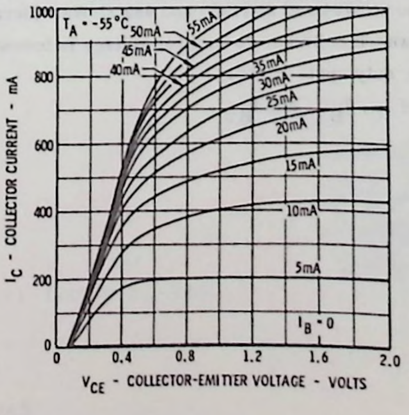
COLLECTOR CHARACTERISTICS



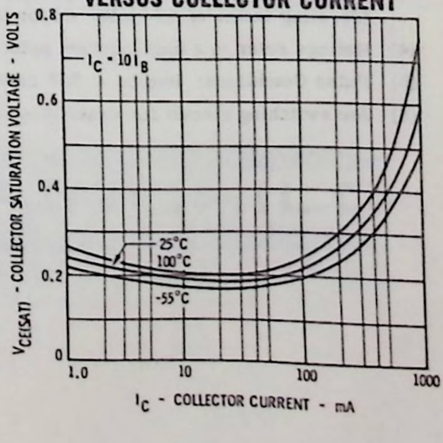
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS

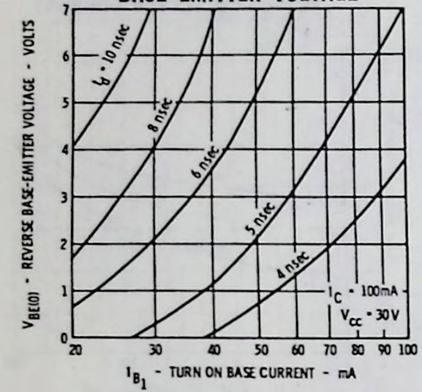


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

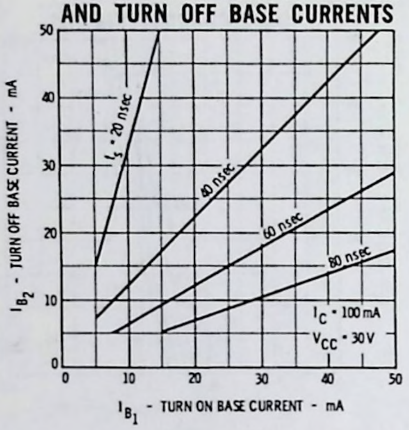


TYPICAL ELECTRICAL CHARACTERISTICS
2N3724 • 2N3725 • 2N4013 • 2N4014

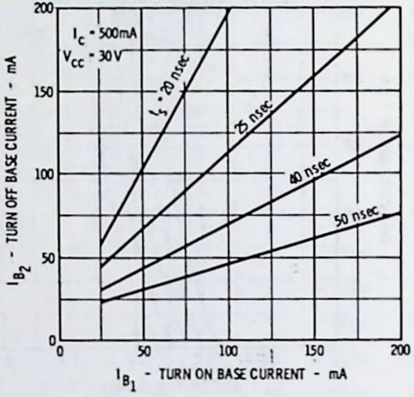
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



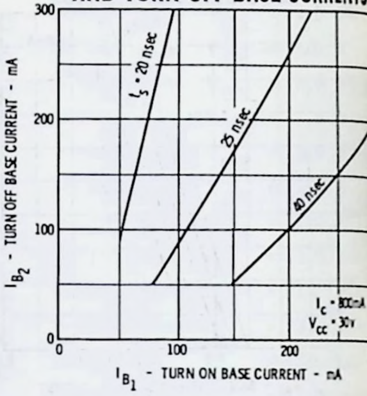
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



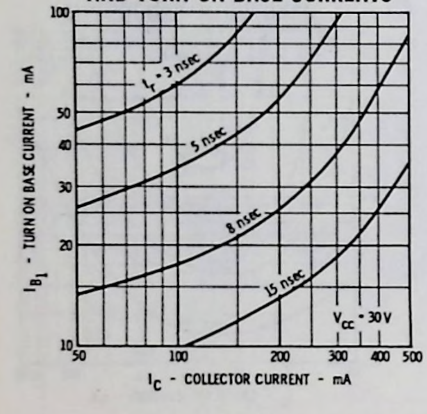
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



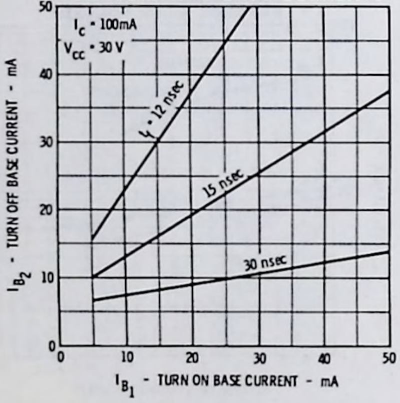
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



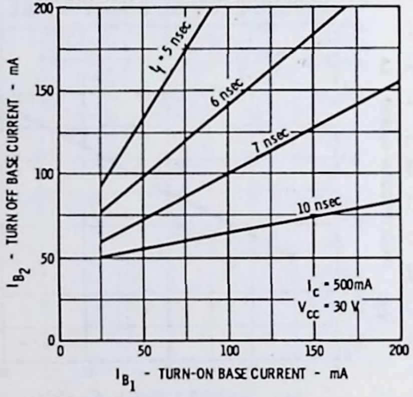
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



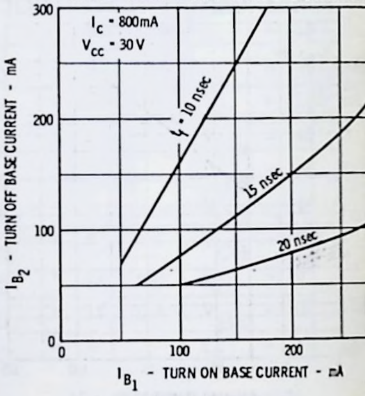
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



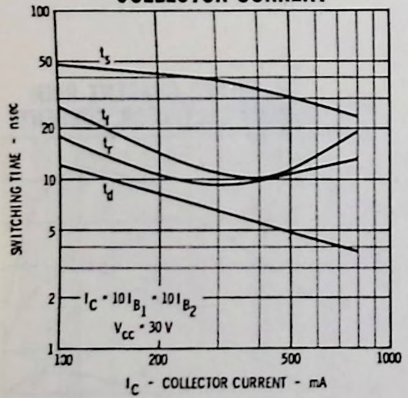
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



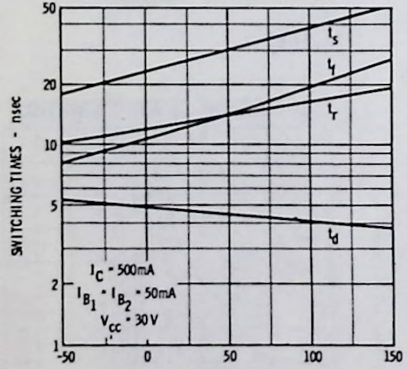
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



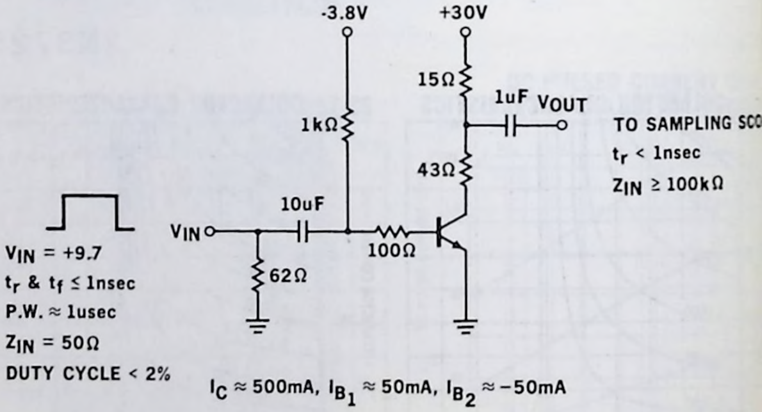
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C) for the 2N3724 and 2N3725, and 146°C/Watt (derating factor of 6.85 mW/°C) for the 2N4013 and 2N4014; junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the 2N3724 and 2N3725, and 485°C/Watt (derating factor of 2.06 mW/°C) for the 2N4013 and 2N4014.

(4) Ratings refer to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuit for exact value of I_C, I_{B1}, and I_{B2}.

2N3734 • 2N3736

NPN HIGH VOLTAGE, HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N3724 • 2N3725

GENERAL DESCRIPTION - The 2N3734 and 2N3736 are High Voltage, High Current NPN Diffused Silicon Planar Epitaxial Transistors useful for memory applications requiring breakdown voltages up to 50 volts and high current capacity with Beta specified to 1.5 amperes.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 10 sec Time Limit)	+230°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

	2N3734	2N3736
Total Dissipation at 25°C Case Temperature	4.0 Watts	2.0 Watts
at 25°C Ambient Temperature	1.0 Watt	0.5 Watt

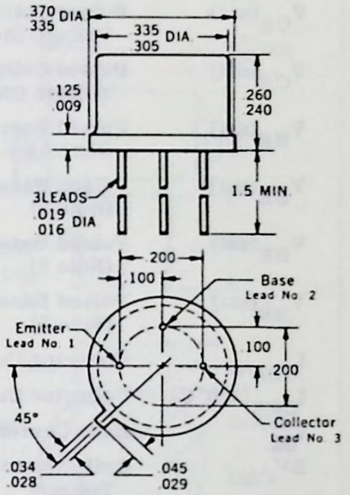
Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	50 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	1.5 Amps

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30		Volts	I_C = 10 mA (pulsed)	I_B = 0
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.9	Volts	I_C = 1.0 A	I_B = 100 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.5	Volts	I_C = 500 mA	I_B = 50 mA
t_d	Delay Time (see Fig. 1)		8.0	nsec	I_C = 1.0 A	I_{B1} = 100 mA
t_r	Rise Time (see Fig. 1)		40	nsec	I_C = 1.0 A	I_{B1} = 100 mA
t_s	Storage Time (see Fig. 2)		30	nsec	I_C = 1.0 A I_{B2} = -100 mA	I_{B1} = 100 mA
t_f	Fall Time (see Fig. 2)		30	nsec	I_C = 1.0 A I_{B2} = -100 mA	I_{B1} = 100 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance		9.0	pf	I_E = 0	V_{CB} = 10 V
C_{ibo}	Input Capacitance		80	pf	I_C = 0	V_{BE} = 0.5 V

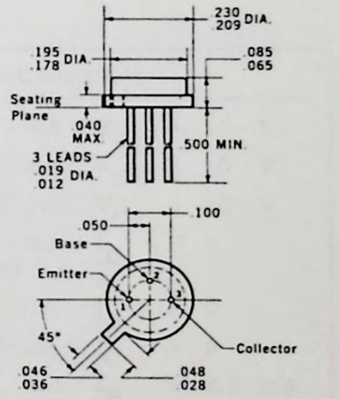
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

2N3734

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

2N3736

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.8°C/watt (derating factor of 22.8 mW/°C) for the 2N3734; and 87.5°C/watt (derating factor of 11.4 mW/°C) for the 2N3736, junction to ambient thermal resistance of 175°C/watt (derating factor of 5.71 mW/°C) for the 2N3734; and 350°C/watt (derating factor of 2.86 mW/°C) for the 2N3736.

(4) Ratings refer to a high current point where collector to emitter voltage is lowest.

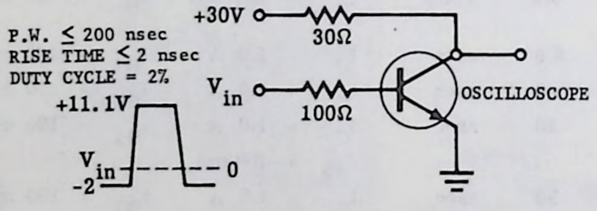
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	40		Volts	I_C = 150 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	35		Volts	I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	35		Volts	I_C = 500 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	120	Volts	I_C = 1.0 A	V_{CE} = 1.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	30		Volts	I_C = 1.5 A	V_{CE} = 5.0 V
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.2	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.3	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		0.8	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		1.0	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		1.2	Volts	I_C = 500 mA	I_B = 50 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)	0.9	1.4	Volts	I_C = 1.0 A	I_B = 100 mA
I_{CEX}	Collector Cutoff Current		0.2	µA	V_{CE} = 25 V	V_{EB} = 2.0 V
I_{CEX}(100°C)	Collector Cutoff Current		20	µA	V_{CE} = 25 V	V_{EB} = 2.0 V
I_{BL}	Base Current		0.3	µA	V_{CE} = 25 V	V_{EB} = 2.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	50		Volts	I_C = 10 µA	I_E = 0
BV_{EBO}	Emitter to Base	5.0		Volts	I_C = 0	I_E = 10 µA
Q_T	Total Control Charge		10	ncoul	I_C = 1.0 A V_{CC} = 30 V	I_B = 100 mA

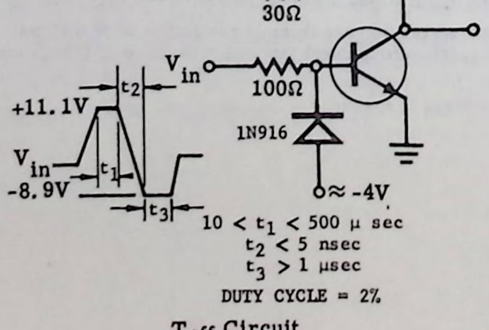
FIGURE 1


P.W. ≤ 200 nsec
RISE TIME ≤ 2 nsec
DUTY CYCLE = 2%
+30V
30Ω
Vin
100Ω
OSCILLOSCOPE
+11.1V
Vin
-2
0

Z_{in} > 100 Kohm
C_{in} ≤ 12 pf
Rise time ≤ 5 nsec

T_{on} Circuit

FIGURE 2


+30V
30Ω
Vin
100Ω
1N916
≈ -4V
+11.1V
Vin
-8.9V
t2
t1
t3
10 < t1 < 500 µ sec
t2 < 5 nsec
t3 > 1 µsec
DUTY CYCLE = 2%

Z_{in} > 100 Kohm
C_{in} ≤ 12 pf
Rise time ≤ 5 nsec

T_{off} Circuit

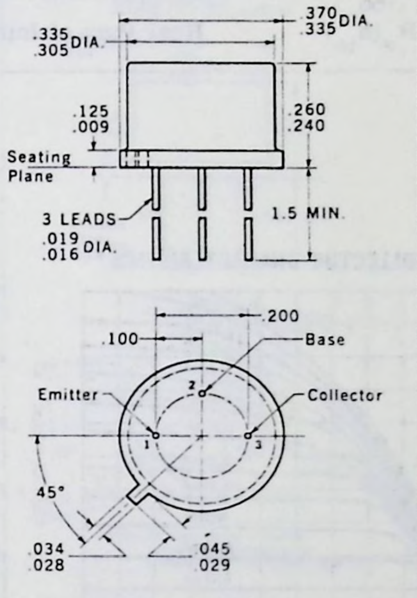
2N3923

NPN HIGH-VOLTAGE AMPLIFIER

DIFFUSED SILICON PLANAR TRANSISTOR

ENERAL DESCRIPTION - The 2N3923 is an NPN silicon PLANAR transistor designed pri-arily for use as a high-voltage output device where low collector base capacitance is required. e device features a maximum C_{obo} of 3.5 pf together with a minimum LV_{CEO} of 150 volts and minimum f_T of 40 Mc. The TO-5 package permits operation to 200°C junction temperature d a power rating of 3 watts.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature		-65°C to +200°C
Operating Junction Temperature		-65°C to +200°C
Lead Temperature (Soldering, 60 sec time limit)		+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	3.0 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.8 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		150 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	150 Volts
V_{EBO}	Emitter to Base Voltage		6.0 Volts
I_C	Collector Current		100 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	30	100	120		I_C = 25 mA V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	15	40			I_C = 25 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	15	62			I_C = 100 μA V_{CE} = 10 V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	150			Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	150			Volts	I_C = 100 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			Volts	I_E = 100 μA I_C = 0
V_{BE}(sat)	Base Saturation Voltage		0.77	0.9	Volts	I_C = 25 mA I_B = 2.5 mA
V_{CE}(sat)	Collector Saturation Voltage		0.3	1.0	Volts	I_C = 25 mA I_B = 2.5 mA

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 58°C/Watt (derating factor of 17.2 mW/°C); junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

This rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μsec; duty cycle = 1%.

FAIRCHILD
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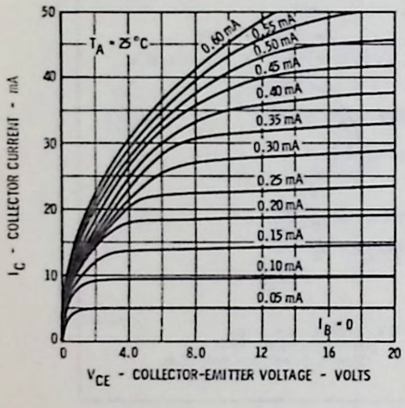
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

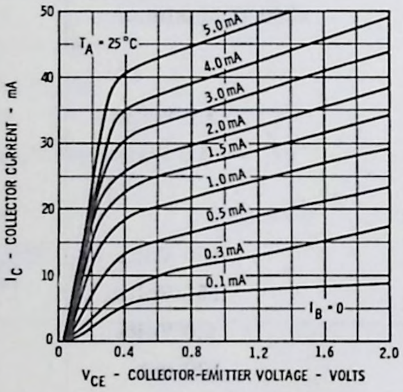
Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions	
I_{CBO}	Collector Cutoff Current		0.1	10	nA	I_E = 0	V_{CB} = 100 V
I_{CBO}(150°C)	Collector Cutoff Current		0.5	10	μA	I_E = 0	V_{CB} = 100 V
I_{EBO}	Emitter Cutoff Current		0.005	50	nA	I_C = 0	V_{EB} = 4.0 V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.0	4.3			I_C = 10 mA	V_{CE} = 10 V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)	20				I_C = 25 mA	V_{CE} = 10 V
C_{obo}	Common Base Open Circuit Output Capacitance		2.6	3.5	pf	I_E = 0	V_{CB} = 20 V
C_{ibo}	Common Base Open Circuit Input Capacitance		17	25	pf	I_C = 0	V_{EB} = 0.5 V
$R_e(h_{ie})$	Real Part of Input Impedance (f = 300 Mc)			50	Ohms	I_C = 10 mA	V_{CE} = 10 V

TYPICAL ELECTRICAL CHARACTERISTICS

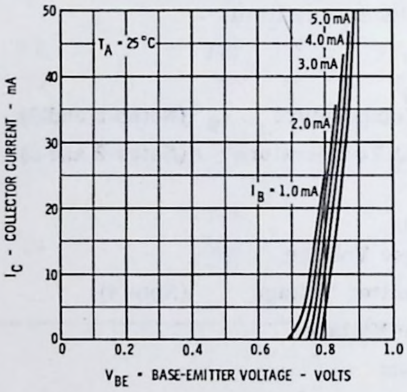
COLLECTOR CHARACTERISTICS*



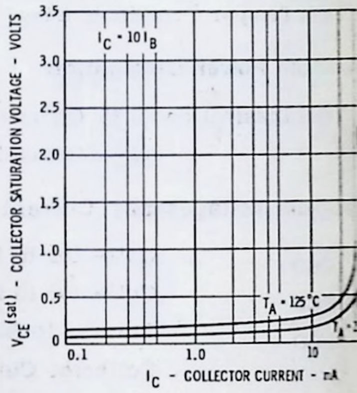
COLLECTOR CHARACTERISTICS*



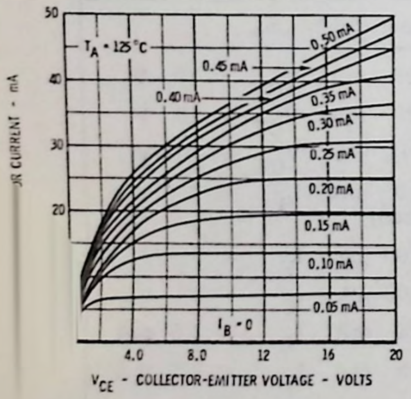
BASE CHARACTERISTICS*



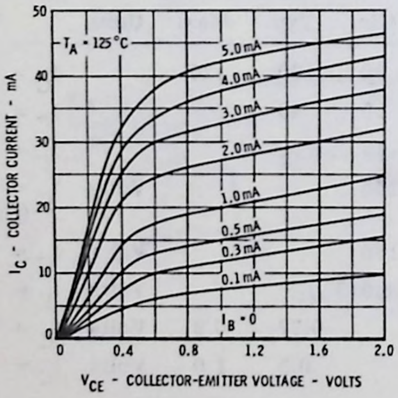
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



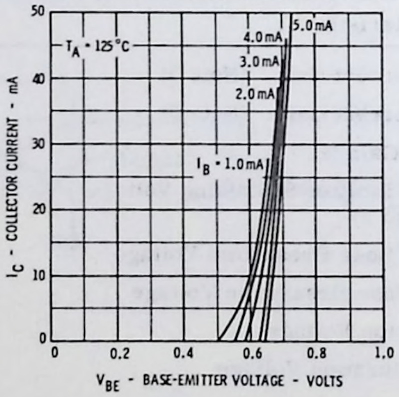
COLLECTOR CHARACTERISTICS*



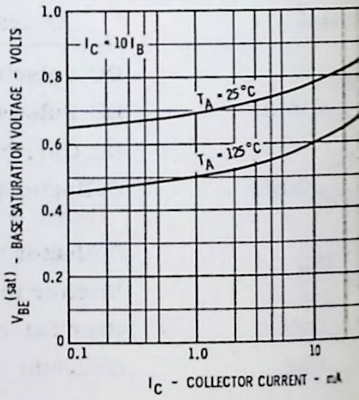
COLLECTOR CHARACTERISTICS*



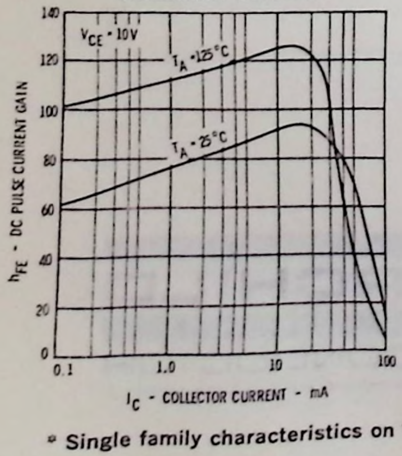
BASE CHARACTERISTICS*



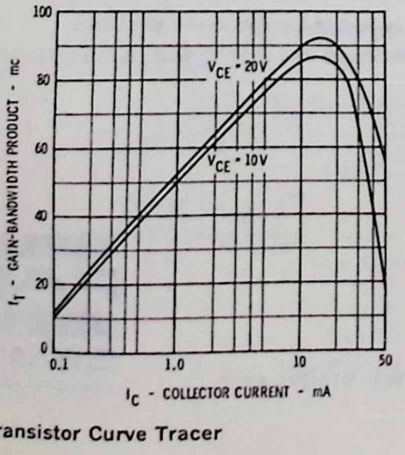
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



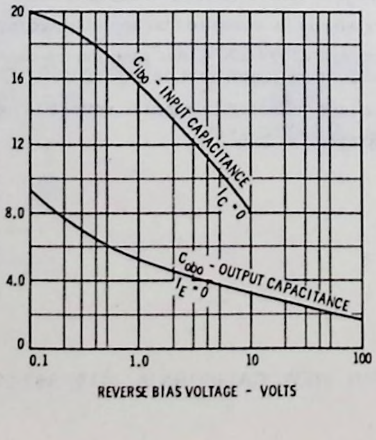
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



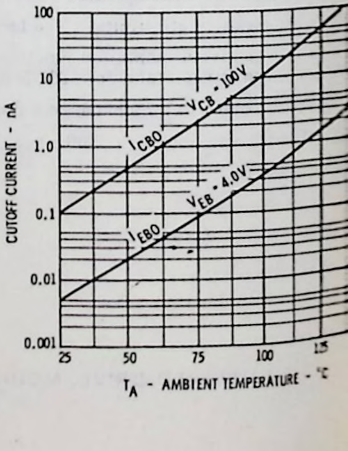
GAIN—BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



COLLECTOR & EMITTER CUTOFF CURRENTS VERSUS AMBIENT TEMPERATU



* Single family characteristics on Transistor Curve Tracer

2N3930 • 2N3931 • 2N4357 • 2N4358

PNP HIGH VOLTAGE AMPLIFIER

DIFFUSED SILICON PLANAR* II TRANSISTORS

ATURES

- **HIGH VOLTAGE -- 240 VOLT LV_{CEO}**
- **HIGH BETA -- 80-300 @ 10 mA**
- **LOW NOISE -- 3 dB @ 1.0 kHz**
- **EXCELLENT BETA LINEARITY from 10 μA to 50 mA**

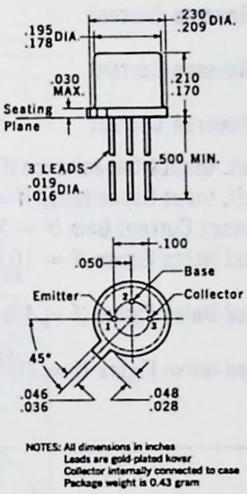
SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C	
Operating Junction Temperature	+200°C	
Lead Temperature (Soldering, 60 second time limit)	+300°C	
	2N3930 2N4357	2N3931 **2N4358**
Maximum Power Dissipation [Notes 2 and 3]		
Total Dissipation at 25°C Case Temperature	1.4 Watts	2.5 Watts
at 25°C Ambient Temperature	0.4 Watt	0.7 Watt

		2N3930 2N3931	2N4357 **2N4358**
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	−180 Volts	−240 Volts
V_{CEO}	Collector to Emitter to Voltage [Note 4]	−180 Volts	−240 Volts
V_{EBO}	Emitter to Base Voltage	−6.0 Volts	−6.0 Volts

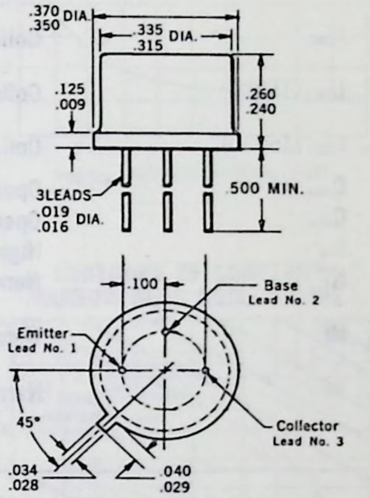
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline


.195
.178 DIA.
.230
.209 DIA.
.030 MAX.
.210
.170
Seating Plane
3 LEADS
.019
.016 DIA.
.500 MIN.
.100
.050
Base
Emitter
Collector
1
2
3
45°
.046
.036
.048
.028

NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

2N3930 • 2N4357

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline


.370
.350 DIA.
.335
.315 DIA.
.125
.009
.260
.240
3LEADS
.019
.016 DIA.
.500 MIN.
.100
Base
Lead No. 2
Emitter
Lead No. 1
Collector
Lead No. 3
45°
.034
.028
.040
.029

NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

2N3931 • 2N4358

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

SYMBOL	CHARACTERISTIC		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	2N3930 2N3931	−180			Volts	$I_C = 10\ \mu A$ $I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	2N4357 2N4358	−240			Volts	$I_C = 10\ \mu A$ $I_E = 0$
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage	2N3930 2N3931	−180			Volts	$I_C = 2.0$ mA $I_B = 0$
$V_{CEO(sust)}$	**Collector to Emitter Sustaining Voltage**	**2N4357 2N4358**	**−240**			**Volts**	$I_C = 2.0$ mA $I_B = 0$
h_{FE}	**DC Current Gain**		**60**	**110**			$I_C = 10\ \mu A$ $V_{CE} = -10$ V
h_{FE}	**DC Current Gain**		**80**	**170**			$I_C = 1.0$ mA $V_{CE} = -10$ V
h_{FE}	**DC Pulse Current Gain** [Note 5]		**80**	**200**	**300**		$I_C = 10$ mA $V_{CE} = -10$ V
h_{FE} (−55°C)	DC Current Gain		15	50			$I_C = 10\ \mu A$ $V_{CE} = -10$ V
h_{FE} (−55°C)	DC Current Gain		30	105			$I_C = 100\ \mu A$ $V_{CE} = -10$ V
$V_{CE(sat)}$	Collector Saturation Voltage	2N3930 2N3931		−0.1	−0.25	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage	2N4357 2N4358		−0.2	−0.5	Volts	$I_C = 10$ mA $I_B = 1.0$ mA

* Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

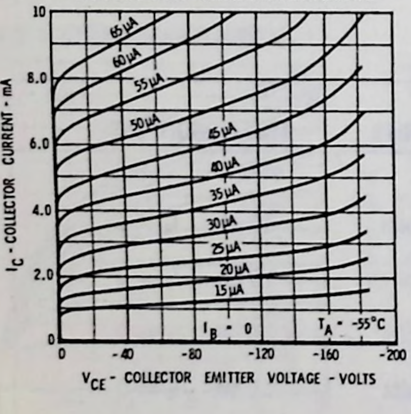
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

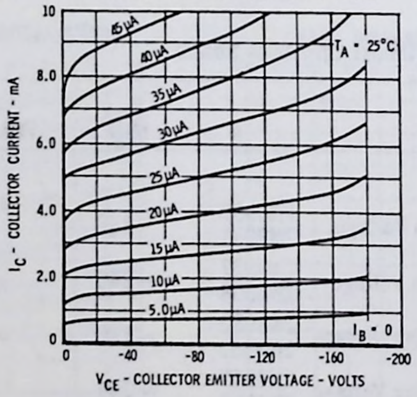
SYMBOL	CHARACTERISTIC		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Base Saturation Voltage			0.74	0.9	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
BV_{EBO}	Emitter to Base Breakdown Voltage		−6.0			Volts	$I_E = 10\ \mu A$	$I_C = 0$
I_{EBO}	Emitter Cutoff Current			0.2	10	nA	$I_C = 0$	$V_{EB} = -4.0$ V
I_{CBO}	Collector Reverse Current	2N3930 2N3931		0.2	10	nA	$I_E = 0$	$V_{CB} = -100$ V
I_{CBO}	Collector Reverse Current	2N4357 2N4358		0.5	20	nA	$I_E = 0$	$V_{CB} = -200$ V
I_{CBO} (150°C)	Collector Reverse Current	2N3930 2N3931		0.03	10	μA	$I_E = 0$	$V_{CB} = -100$ V
I_{CBO} (150°C)	Collector Reverse Current	2N4357 2N4358		0.07	20	μA	$I_E = 0$	$V_{CB} = -200$ V
C_{obo}	Open Circuit, Output Capacitance (f = 1.0 MHz)			5.0	7.0	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{ibo}	Open Circuit, Input Capacitance (f = 1.0 MHz)			20	25	pF	$I_C = 0$	$V_{EB} = -0.5$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)		2.0	3.0	8.0		$I_C = 1.0$ mA	$V_{CE} = -10$ V
NF	Narrow Band Noise Figure (f = 10 kHz)			1.0	3.0	dB	$I_C = 10\ \mu A$ $R_S = 10$ kΩ	$V_{CE} = -5.0$ V BW = 1.5 kHz
NF	Narrow Band Noise Figure (f = 1.0 kHz)			1.0	3.0	dB	$I_C = 10\ \mu A$ $R_S = 10$ kΩ	$V_{CE} = -5.0$ V BW = 150 Hz
NF	Narrow Band Noise Figure (f = 100 Hz)			2.0	10	dB	$I_C = 10\ \mu A$ $R_S = 10$ kΩ	$V_{CE} = -5.0$ V BW = 15 Hz

TYPICAL ELECTRICAL CHARACTERISTICS

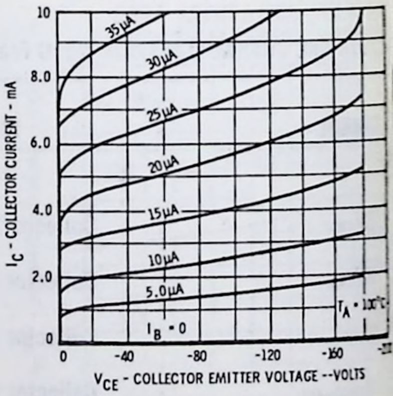
COLLECTOR CHARACTERISTICS*



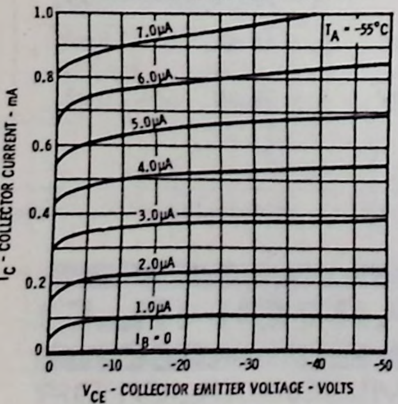
COLLECTOR CHARACTERISTICS*



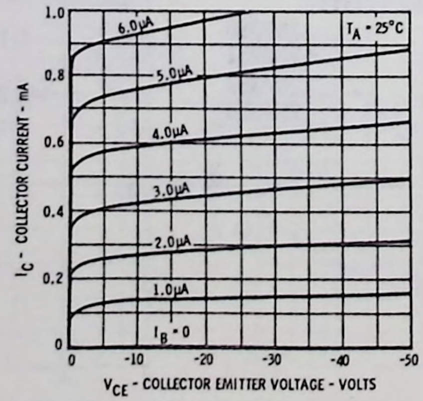
COLLECTOR CHARACTERISTICS*



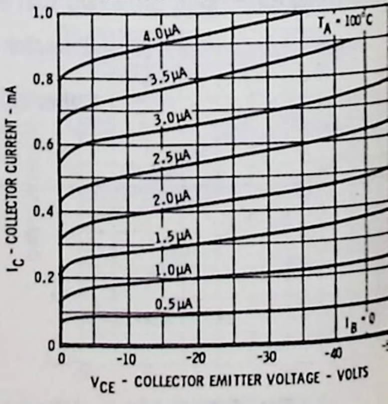
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



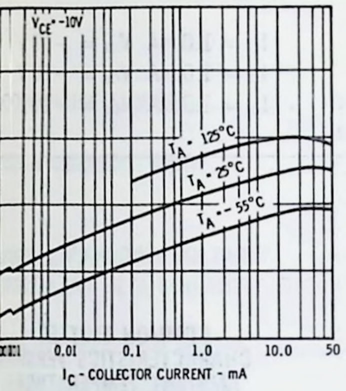
COLLECTOR CHARACTERISTICS*



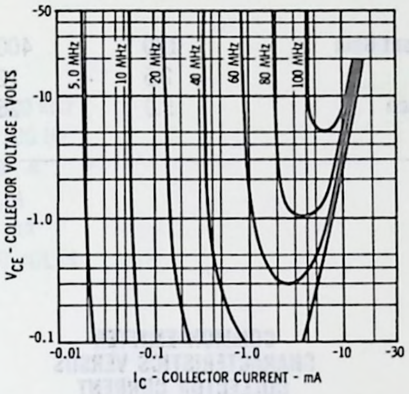
* *Single family characteristic on Transistor Curve Tracer.*

TYPICAL ELECTRICAL CHARACTERISTICS

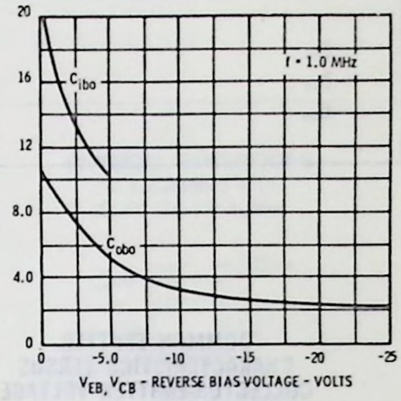
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



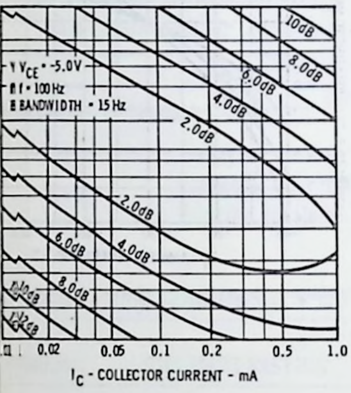
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_t)



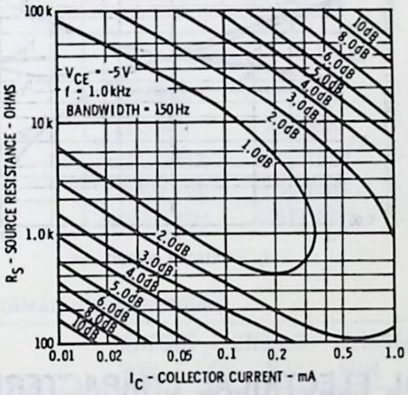
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



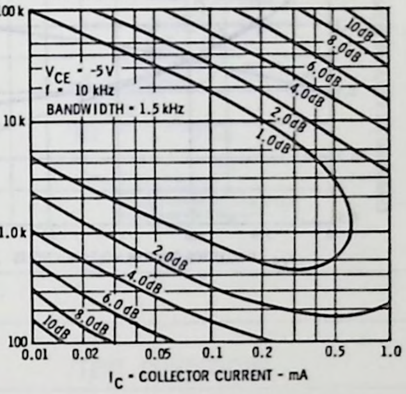
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



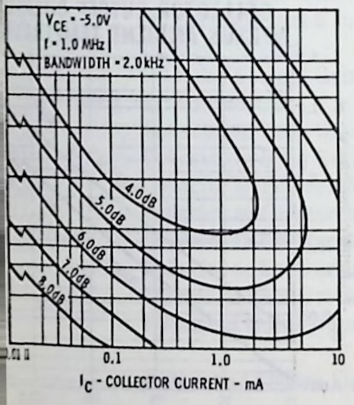
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



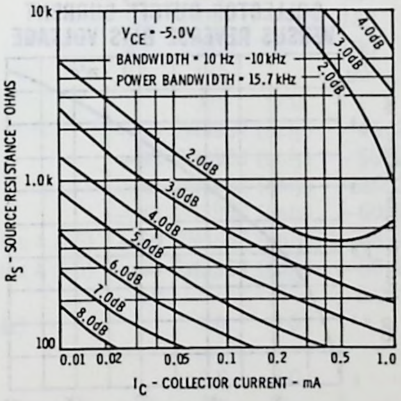
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



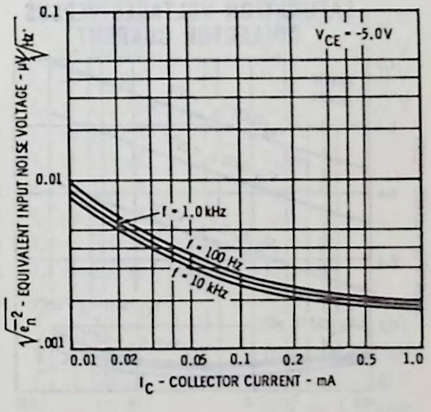
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



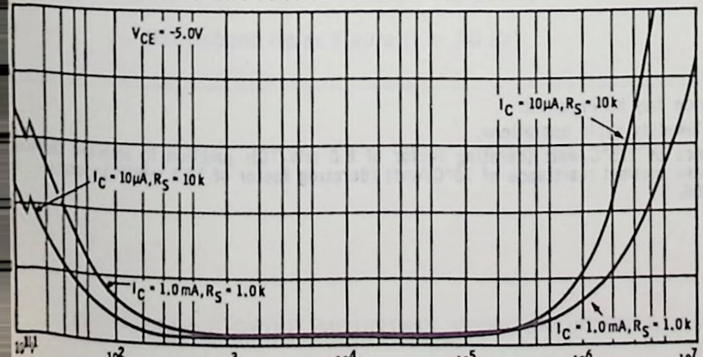
CONTOURS OF CONSTANT WIDE BAND NOISE FIGURE



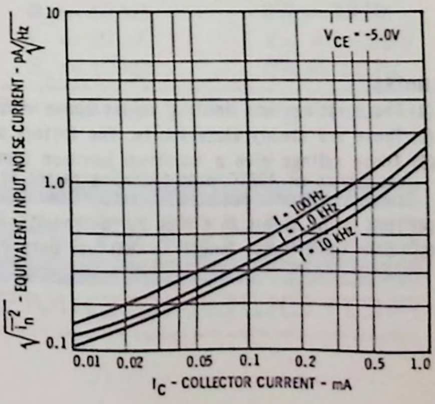
EQUIVALENT INPUT NOISE VOLTAGE VERSUS COLLECTOR CURRENT



SPOT NOISE FIGURE VERSUS FREQUENCY



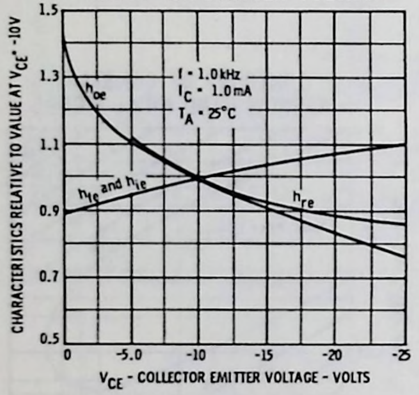
EQUIVALENT INPUT NOISE CURRENT VERSUS COLLECTOR CURRENT



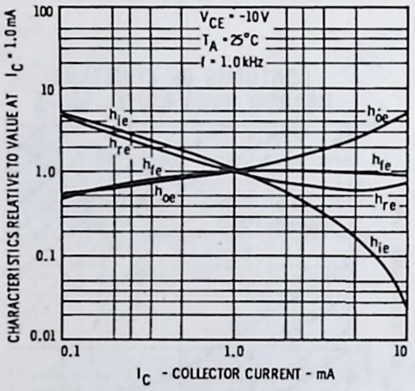
SMALL SIGNAL CHARACTERISTICS ($f = 1.0$ kHz, $T_A = 25°C$)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
h_{fe}	Small Signal Current Gain	100	400		$I_C = 1.0$ mA $V_{CE} = -10$ V
h_{ie}	Input Resistance	2.5	12	kOhms	$I_C = 1.0$ mA $V_{CE} = -10$ V
h_{oe}	Output Conductance	5.0	25	μmhos	$I_C = 1.0$ mA $V_{CE} = -10$ V

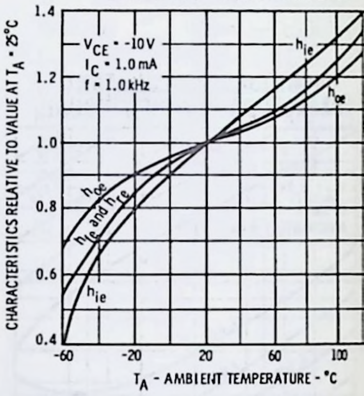
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT

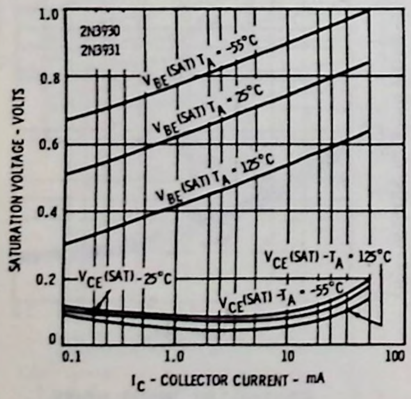


COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE

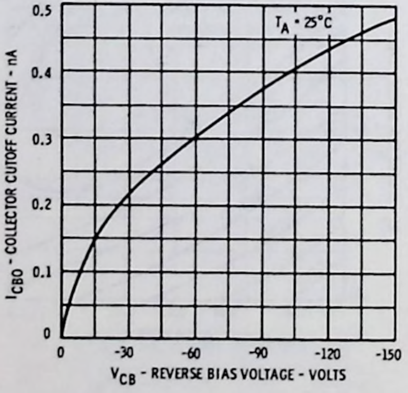


TYPICAL ELECTRICAL CHARACTERISTICS

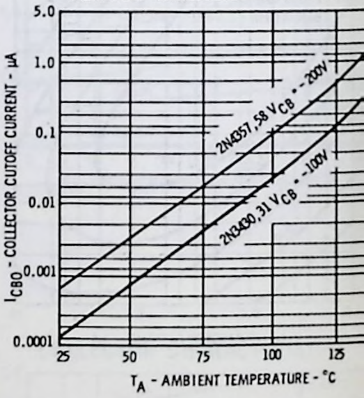
COLLECTOR AND BASE SATURATION VOLTAGES VERSUS COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR CUTOFF CURREN VERSUS AMBIENT TEMPERATU



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low-duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 125°C/watt (derating factor of 8.0 mW/°C); junction to ambient therma resistance of 438°C/watt (derating factor of 2.28 mW/°C) for the 2N3920 and 2N4357; junction to case thermal resistance of 70°C/watt (derating factor of 14.3 mW/°C); junction t ambient thermal resistance of 250°C/watt (derating factor of 4.0 mW/°C) for the 2N3931 and 2N4358.

(4) This rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

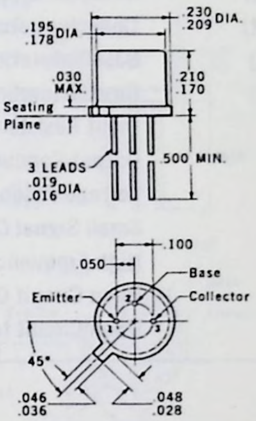
2N3962 • 2N3963 • 2N3964 • 2N3965

PNP LOW-LEVEL, LOW-NOISE TYPE

DIFFUSED SILICON PLANAR* II TRANSISTORS

LOW NOISE FIGURE . . . . NF = 2.0 dB (MAX) AT 1.0 kHz
NF = 4.0 dB (MAX) AT 100 Hz
HIGH CURRENT GAIN . . . . h_{FE} = 180 (MIN) AT 1.0 μA
h_{FE} = 250 - 500 AT 10 μA
h_{FE} = 250 - 600 AT 1.0 mA
HIGH BREAKDOWN VOLTAGE . . . LV_{CEO} = 45, 60 AND 80 VOLTS
EXCELLENT BETA LINEARITY FROM 1.0 μA TO 50 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C
Lead Temperature (Soldering, 60 second time limit)	300°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.2 Watts
at 25°C Ambient Temperature	0.36 Watt

Maximum Voltages and Current

		2N3962 2N3965	2N3963	2N3964
V_{CBO}	Collector to Base Voltage	−60 Volts	−80 Volts	−45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−60 Volts	−80 Volts	−45 Volts
V_{EBO}	Emitter to Base Voltage	−6.0 Volts	−6.0 Volts	−6.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N3962 • 2N3963 MIN.	TYP.	MAX.	2N3964 • 2N3965 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	60	175		**180**	**300**			I_C = 1.0 μA	V_{CE} = −5.0 V
h_{FE}	**DC Current Gain**	100	210	300	**250**	**320**	**500**		I_C = 10 μA	V_{CE} = −5.0 V
h_{FE}	DC Current Gain	100	240		250	330			I_C = 100 μA	V_{CE} = −5.0 V
h_{FE}	DC Current Gain	100	260	450	**250**	**330**	**600**		I_C = 1.0 mA	V_{CE} = −5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	100	280		200	330			I_C = 10 mA	V_{CE} = −5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	90	260		180	315			I_C = 50 mA	V_{CE} = −5.0 V
h_{FE}(−55°C)	DC Current Gain	40	90		100	160			I_C = 10 μA	V_{CE} = −5.0 V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	45	150		90	190			I_C = 50 mA	V_{CE} = −5.0 V
h_{FE}(+100°C)	DC Current Gain		375	600		400	800		I_C = 1.0 mA	V_{CE} = −5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	−60	2N3962 (only)		−45	2N3964 (only)		Volts	I_C = 10 μA	I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−80	2N3963 (only)		−60	2N3965 (only)		Volts	I_C = 10 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−60	2N3962 (only)		−45	2N3964 (only)		Volts	I_C = 10 μA	I_B = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−80	2N3963 (only)		−60	2N3965 (only)		Volts	I_C = 10 μA	I_B = 0
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 & 5)	**−60**	**2N3962** (only)		**−45**	**2N3964** (only)		**Volts**	I_C = 5.0 mA (pulsed)	I_B = 0
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 & 5)	**−80**	**2N3963** (only)		**−60**	**2N3965** (only)		**Volts**	I_C = 5.0 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−6.0			−6.0			Volts	I_C = 0	I_E = 10 μA
NF	Wideband Noise Figure (f = 10 Hz to 10 kHz)		1.0	3.0		0.7	2.0	dB	I_C = 20 μA R_S = 10 kΩ	V_{CE} = −5.0 V BW = 15.7 kHz
NF	Narrowband Noise Figure (f = 10 kHz)		0.8	3.0		0.5	2.0	dB	I_C = 20 μA R_S = 10 kΩ	V_{CE} = −5.0 V BW = 1.5 kHz
NF	**Narrowband Noise Figure (f = 1.0 kHz)**		0.8	3.0		**0.5**	**2.0**	**dB**	**I_C = 20 μA** **R_S = 10 kΩ**	**V_{CE} = −5.0 V** **BW = 150 Hz**
NF	**Narrowband Noise Figure (f = 100 Hz)**		3.0	10		**1.8**	**4.0**	**dB**	**I_C = 20 μA** **R_S = 10 kΩ**	**V_{CE} = −5.0 V** **BW = 15 Hz**
NF	Narrowband Noise Figure (f = 10 Hz)					3.5	8.0	dB	I_C = 20 μA R_S = 10 kΩ	V_{CE} = −5.0 V BW = 2.0 Hz

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS 2N3962 • 2N3963 • 2N3964 • 2N3965

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3962 • 2N3963			2N3964 • 2N3965					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CES}	Collector Reverse Current	(2N3962)	0.5	10	(2N3965)	0.5	10	nA	$V_{CE} = -50$ V	$V_{EB} = 0$
I_{CES}	Collector Reverse Current	(2N3963)	0.5	10				nA	$V_{CE} = -70$ V	$V_{EB} = 0$
I_{CES}	Collector Reverse Current				(2N3964)	0.5	10	nA	$V_{CE} = -40$ V	$V_{EB} = 0$
$I_{CES}(+150°C)$	Collector Reverse Current	(2N3962)	2.0	10	(2N3965)	0.5	10	μA	$V_{CE} = -50$ V	$V_{EB} = 0$
$I_{CES}(+150°C)$	Collector Reverse Current	(2N3963)	2.0	10				μA	$V_{CE} = -70$ V	$V_{EB} = 0$
$I_{CES}(+150°C)$	Collector Reverse Current				(2N3964)	2.0	10	μA	$V_{CE} = -40$ V	$V_{EB} = 0$
I_{EBO}	Emitter Cutoff Current			10			10	nA	$I_C = 0$	$V_{EB} = -4.0$ V
$V_{CE}(sat)$	Collector Saturation Voltage		−0.1	−0.25		−0.1	−0.25	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
$V_{CE}(sat)$	Collector Saturation Voltage (Note 5)		−0.16	−0.4		−0.16	−0.4	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage		−0.72	−0.9		−0.72	−0.9	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
$V_{BE}(sat)$	Base Saturation Voltage (Note 5)		−0.81	−0.95		−0.81	−0.95	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
h_{ie}	Input Resistance (f = 1.0 kHz)	2.5	8.0	17	6.0	10	20	kΩ	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{oe}	Output Conductance (f = 1.0 kHz)	5.0	19	40	5.0	25	50	μmho	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)			10			10	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	100	300	550	250	360	700		$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0		8.0	2.5		8.0		$I_C = 0.5$ mA	$V_{CE} = -5.0$ V
C_{obo}	Open Circuit Output Capacitance			6.0			6.0	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{ibo}	Open Circuit Input Capacitance			15			15	pF	$I_C = 0$	$V_{EB} = -0.5$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).

(4) This rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N4026 THROUGH 2N4029

PNP HIGH-VOLTAGE GENERAL PURPOSE AMPLIFIERS

SILICON PLANAR*II EPITAXIAL TRANSISTORS

TURES

- **GH BETA--100-300 @ 100 mA**
- **GH VOLTAGE--60 AND 80 VOLTS LV_{CEO}**
- **W V_{CE} (SAT)--1.0 VOLT (MAX.) @ 1.0 A**
- **CELLENT BETA LINEARITY FROM 100 μA TO 500 mA**

LUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

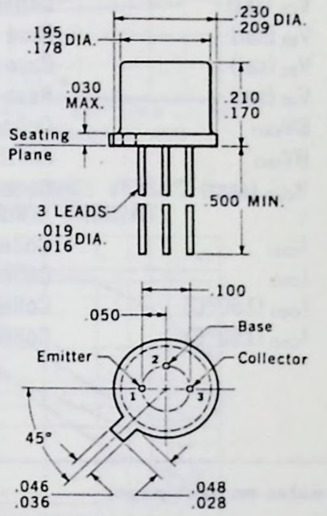
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		+200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)		+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	[Notes 2 and 3]	2.0 Watts
at 25°C Free Air Temperature	[Notes 2 and 3]	0.5 Watt

Maximum Voltages

			2N4026 **2N4028**	2N4027 **2N4029**
V_{CBO}	Collector to Base Voltage		−60 Volts	−80 Volts
V_{CEO}	Collector to Emitter Voltage	[Note 4]	**−60 Volts**	**−80 Volts**
V_{EBO}	Emitter to Base Voltage		−5.0 Volts	−5.0 Volts


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline

NOTES: All dimensions in inches
Leads are gold-plated kovar
Gate internally connected to case
Package weight is 0.43 gram

RICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N4026 2N4027 Min.	Typ.	Max.	**2N4028** **2N4029** Min.	Typ.	Max.	UNITS	TEST CONDITIONS
h_{FE}	**DC Pulse Current Gain** [Note 5]	30	80		**75**	**150**			**$I_C = 100\ \mu A$** $V_{CE} = -5.0\ V$
h_{FE}	**DC Pulse Current Gain** [Note 5]	40	80	120	**100**	**160**	**300**		**$I_C = 100\ mA$** $V_{CE} = -5.0\ V$
h_{FE}	**DC Pulse Current Gain** [Note 5]	25	60		**70**	**110**			**$I_C = 500\ mA$** $V_{CE} = -5.0\ V$
h_{FE}	**DC Pulse Current Gain** [Note 5]	15 (2N4026 only)			**40 (2N4028 only)**				**$I_C = 1.0\ A$** $V_{CE} = -5.0\ V$
h_{FE}	**DC Pulse Current Gain** [Note 5]	10 (2N4027 only)			**25 (2N4029 only)**				**$I_C = 1.0\ A$** $V_{CE} = -5.0\ V$
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	15	50		40	100			$I_C = 100\ mA$ $V_{CE} = -5.0\ V$
h_{fe}	**High Frequency Current Gain** (f = 100 MHz)	1.0	1.5	4.0	**1.5**	**2.0**	5.0		$I_C = 50\ mA$ $V_{CE} = -10\ V$
C_{obo}	Common-Base, Open-Circuit Output Capacitance		15	20		15	20	pF	$I_E = 0$ $V_{CB} = -10\ V$
C_{ibo}	Common-Base, Open-Circuit Input Capacitance		75	110		75	110	pF	$I_C = 0$ $V_{EB} = -0.5\ V$
t_{on}	Turn On Time [Note 6]		30	100		23	100	ns	$I_C \approx 500\ mA$, $I_{B1} \approx 50\ mA$
t_s	Storage Time [Note 6]		150	350		175	350	ns	$I_C \approx 500\ mA$, $I_{B1} \approx 50\ mA$, $I_{B2} \approx -50\ mA$
t_f	Fall Time [Note 6]		25	50		22	50	ns	$I_C \approx 500\ mA$, $I_{B1} \approx 50\ mA$, $I_{B2} \approx -50\ mA$

*Planar is a patented Fairchild Process.

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS 2N4026 THROUGH 2N4029

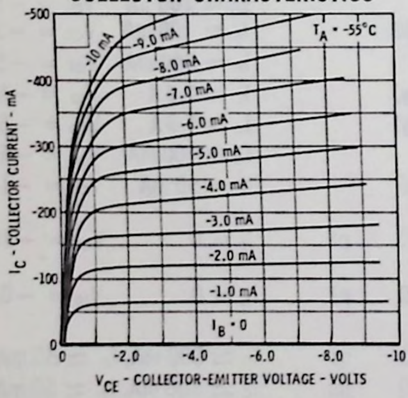
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N4026 2N4028 Min.	Typ.	Max.	2N4027 2N4029 Min.	Typ.	Max.	Units	TEST CONDITIONS	
V_{CE} (sat)	Collector Saturation Voltage [Note 5]		−0.1	−0.15		−0.1	−0.15	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE} (sat)	Collector Saturation Voltage [Note 5]		−0.25	−0.5		−0.25	−0.5	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{CE} (sat)	Collector Saturation Voltage [Note 5]		−0.5	−1.0				Volts	$I_C = 1000$ mA	$I_B = 100$ mA
V_{BE} (sat)	Base Saturation Voltage [Note 5]		−0.8	−0.9		−0.8	−0.9	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{BE} (sat)	Base Saturation Voltage [Note 5]			−1.1		−0.95	−1.1	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE} (sat)	Base Saturation Voltage [Note 5]		−1.05	−1.2				Volts	$I_C = 1000$ mA	$I_B = 100$ mA
BV_{CBO}	Collector to Base Breakdown Voltage	−60			−80			Volts	$I_E = 0$	$I_C = 10\ \mu A$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	−60			−80			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
I_{CBO}	Collector Cutoff Current		0.2	50				nA	$I_E = 0$	$V_{CB} = -50$ V
I_{CBO}	Collector Cutoff Current					0.2	50	nA	$I_E = 0$	$V_{CB} = -60$ V
I_{CBO} (150°C)	Collector Cutoff Current		0.2	50				μA	$I_E = 0$	$V_{CB} = -50$ V
I_{CBO} (150°C)	Collector Cutoff Current					0.25	50	μA	$I_E = 0$	$V_{CB} = -60$ V

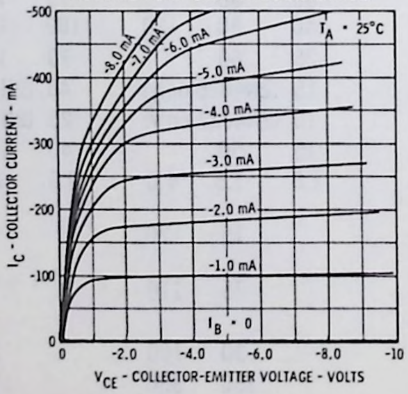
(See notes on back page)

TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4026 AND 2N4027

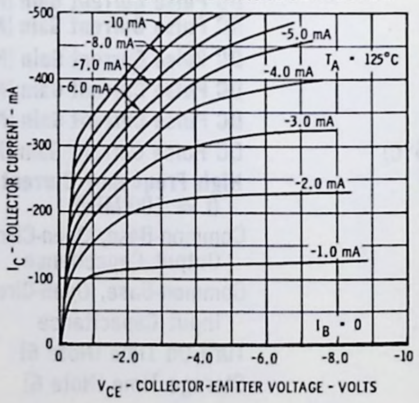
COLLECTOR CHARACTERISTICS*



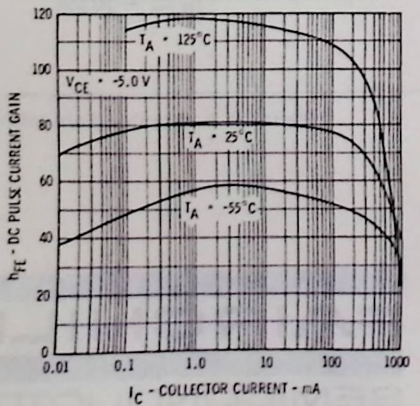
COLLECTOR CHARACTERISTICS*



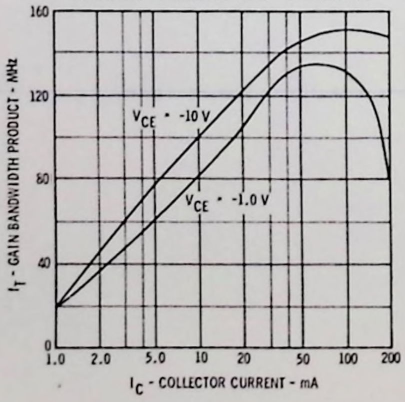
COLLECTOR CHARACTERISTICS*



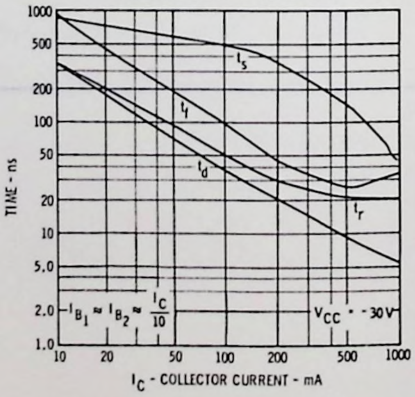
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



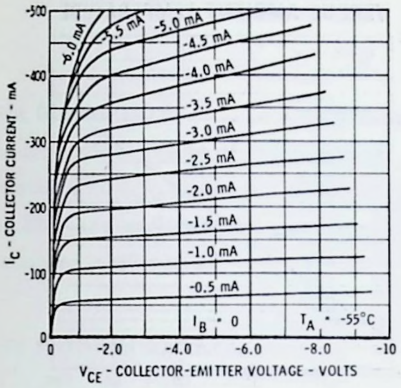
SWITCHING TIMES VERSUS COLLECTOR CURRENT



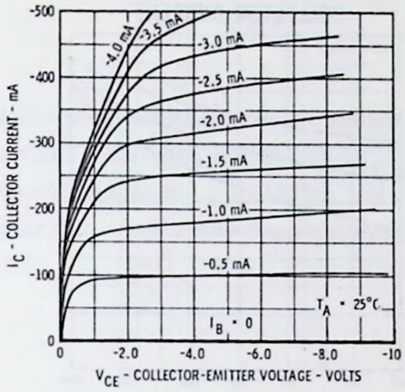
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4028 AND 2N4029

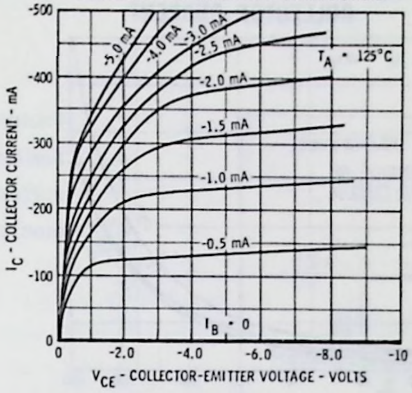
COLLECTOR CHARACTERISTICS*



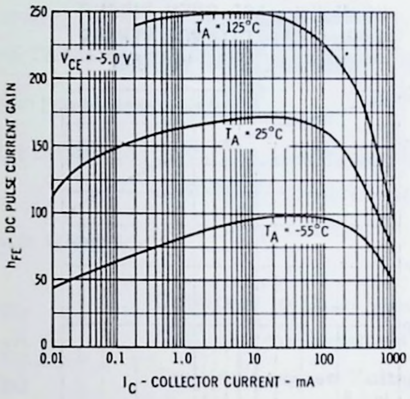
COLLECTOR CHARACTERISTICS*



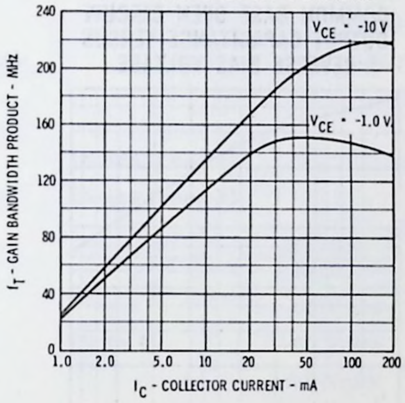
COLLECTOR CHARACTERISTICS*



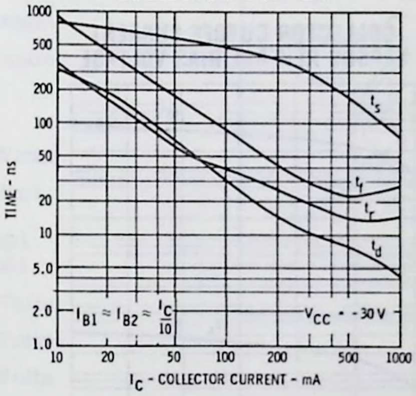
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

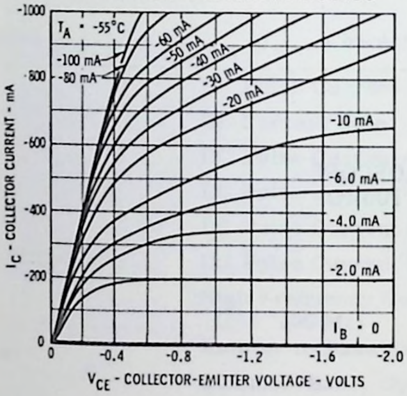


SWITCHING TIMES VERSUS COLLECTOR CURRENT

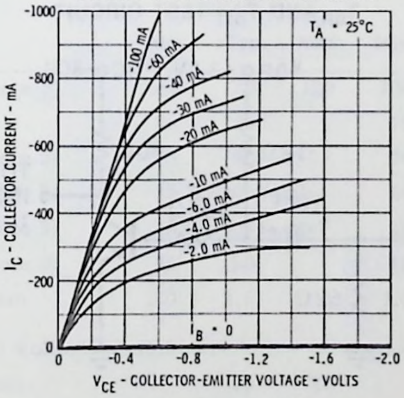


TYPICAL ELECTRICAL CHARACTERISTICS (All Types)

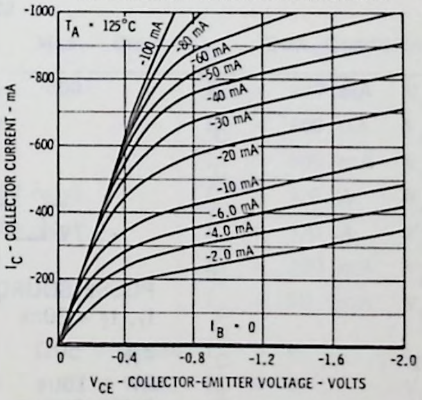
COLLECTOR CHARACTERISTICS*



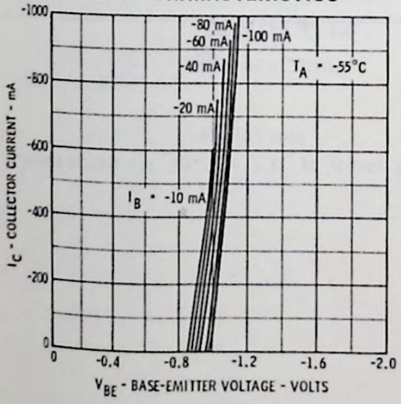
COLLECTOR CHARACTERISTICS*



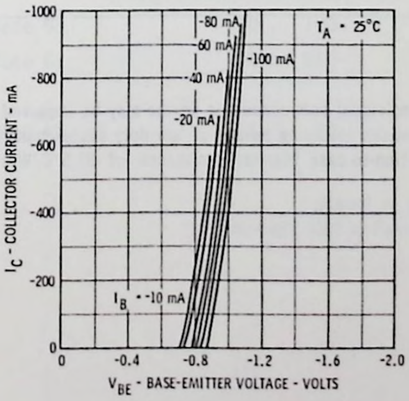
COLLECTOR CHARACTERISTICS*



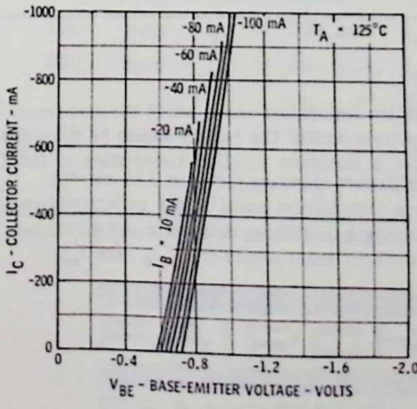
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



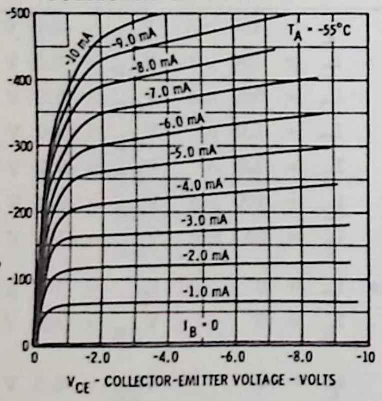
* Single family characteristic on Transistor Curve Tracer.

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

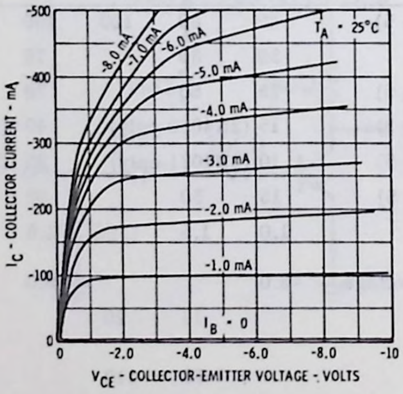
Symbol	Characteristic	2N4030 2N4032 Min.	Typ.	Max.	2N4031 2N4033 Min.	Typ.	Max.	Units	Test Conditions	
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		-0.1	-0.15		-0.1	-0.15	Volts	I_C = 150 mA	I_B = 15 m
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		-0.25	-0.5		-0.25	-0.5	Volts	I_C = 500 mA	I_B = 50 m
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		-0.5	-1.0				Volts	I_C = 1000 mA	I_B = 100 m
V_{BE}(sat)	Base Saturation Voltage (Note 5)		-0.8	-0.9		-0.8	-0.9	Volts	I_C = 150 mA	I_B = 15 m
V_{BE}(sat)	Base Saturation Voltage (Note 5)		-0.95	-1.1		-0.95	-1.1	Volts	I_C = 500 mA	I_B = 50 m
V_{BE}(sat)	Base Saturation Voltage (Note 5)		-1.05	-1.2				Volts	I_C = 1000 mA	I_B = 100 m
BV_{CBO}	Collector to Base Breakdown Voltage	-60			-80			Volts	I_E = 0	I_C = 10 μ
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	-60			-80			Volts	I_C = 10 mA (pulsed)	I_B = 0
I_{CBO}	Collector Cutoff Current		0.2	50				nA	I_E = 0	V_{CB} = -50 V
I_{CBO}	Collector Cutoff Current					0.2	50	nA	I_E = 0	V_{CB} = -60 V
I_{CBO}(150°C)	Collector Cutoff Current		0.2	50				μA	I_E = 0	V_{CB} = -50 V
I_{CBO}(150°C)	Collector Cutoff Current					0.25	50	μA	I_E = 0	V_{CB} = -60 V

TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4030 AND 2N4031

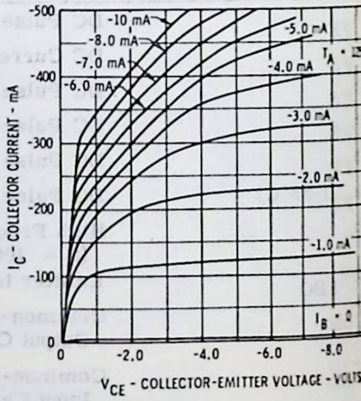
COLLECTOR CHARACTERISTICS*



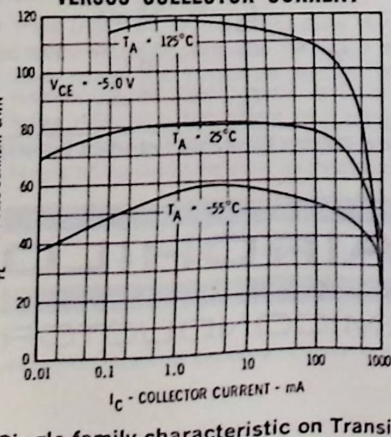
COLLECTOR CHARACTERISTICS*



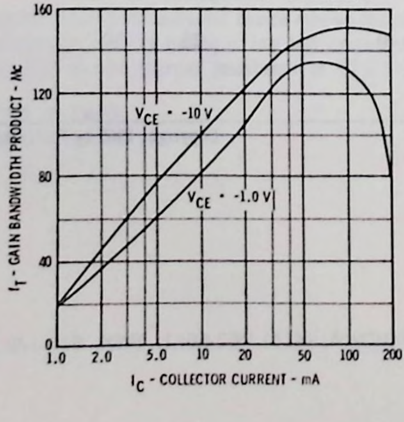
COLLECTOR CHARACTERISTICS



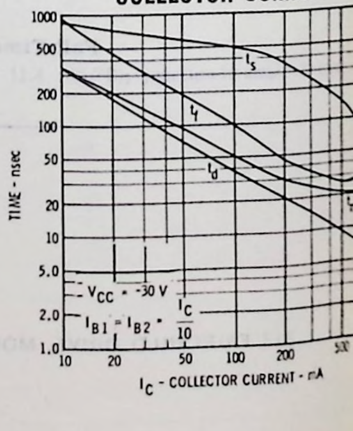
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

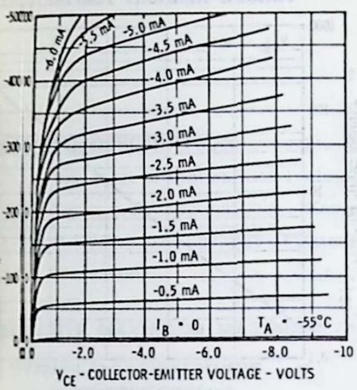


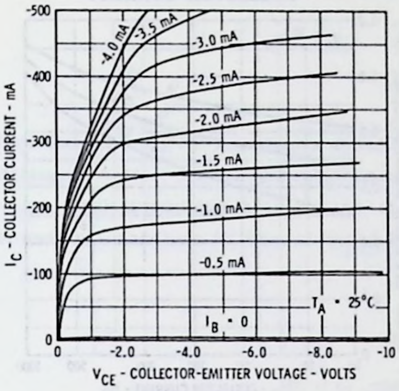
SWITCHING TIMES VERSUS COLLECTOR CURRENT

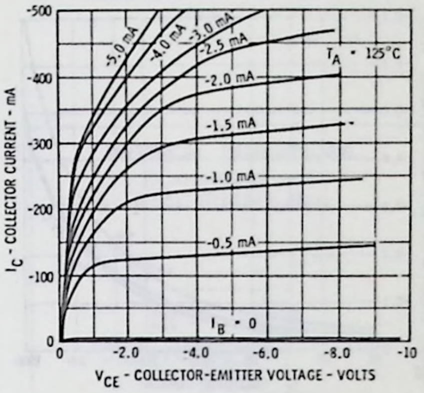


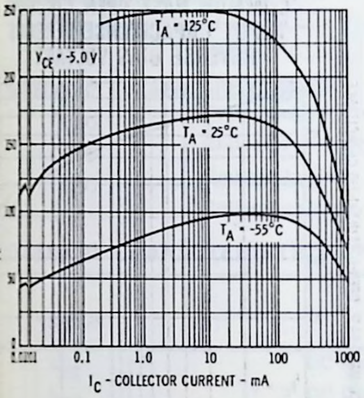
* *Single family characteristic on Transistor Curve Tracer.*

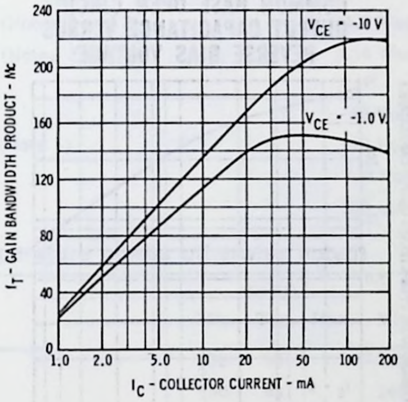
TYPICAL ELECTRICAL CHARCTERISTICS FOR 2N4032 AND 2N4033

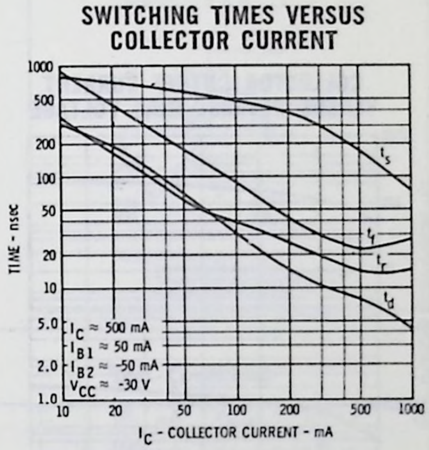

COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*

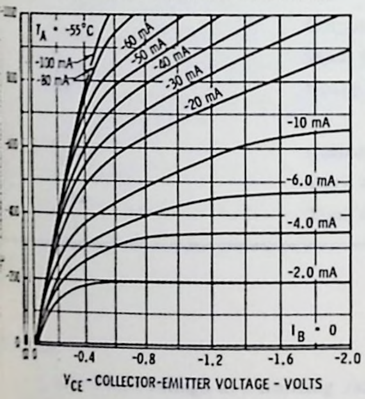

COLLECTOR CHARACTERISTICS*

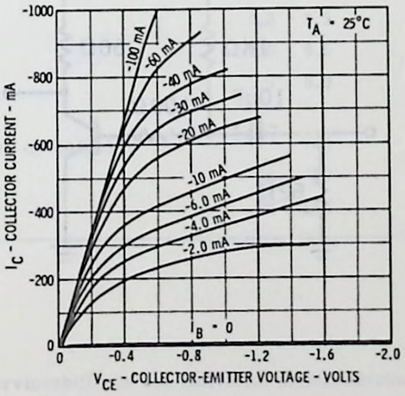

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

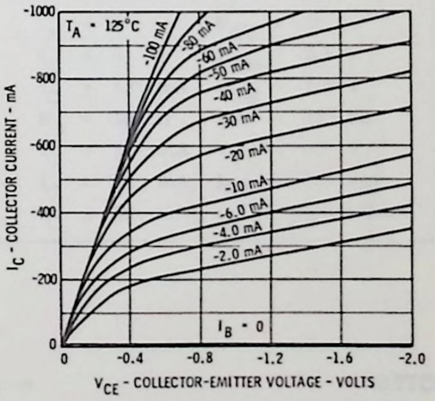

GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

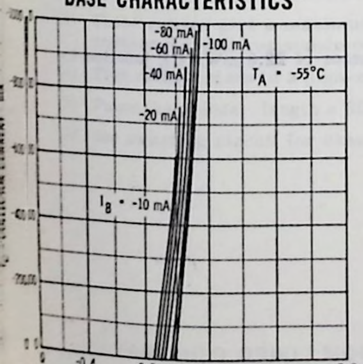

SWITCHING TIMES VERSUS COLLECTOR CURRENT

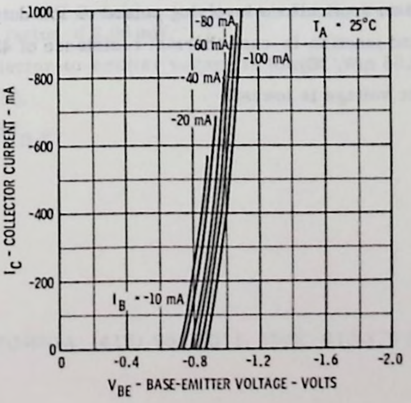
TYPICAL ELECTRICAL CHARACTERISTICS (All Types)

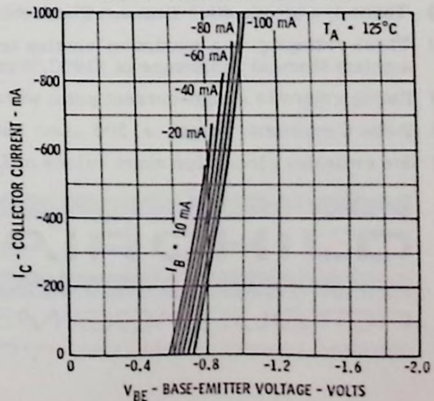

COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*


BASE CHARACTERISTICS*

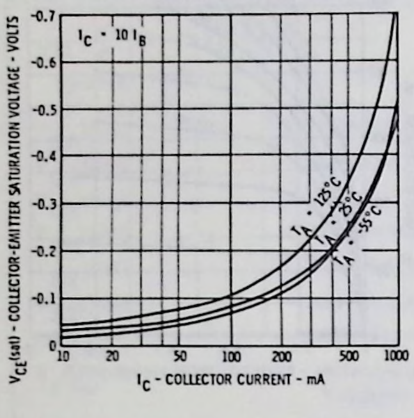

BASE CHARACTERISTICS*


BASE CHARACTERISTICS*

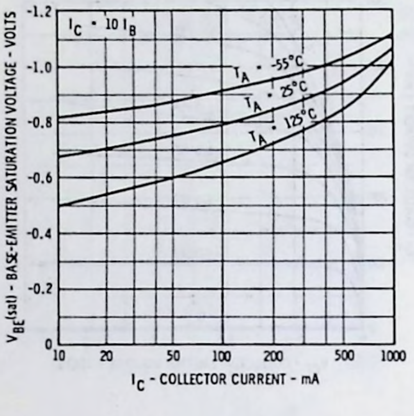
*Simple family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS (All Types)

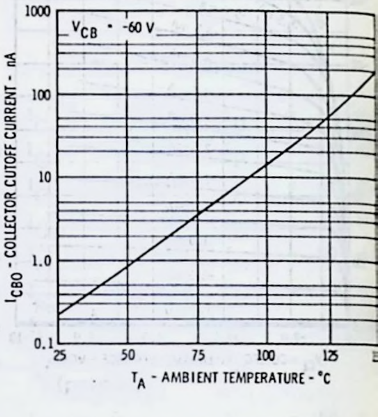
COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



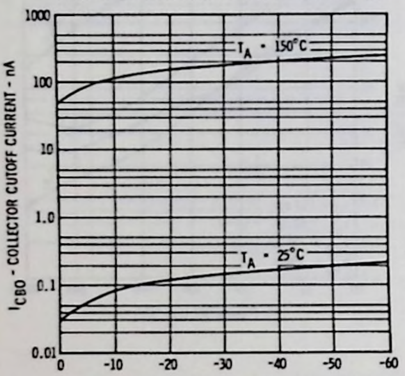
BASE-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



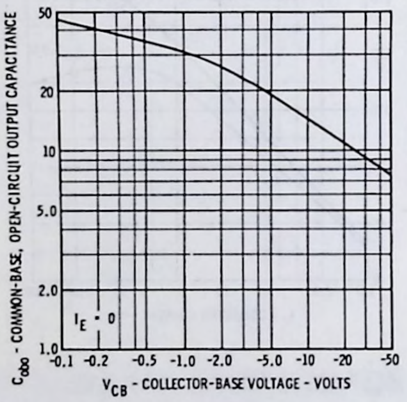
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



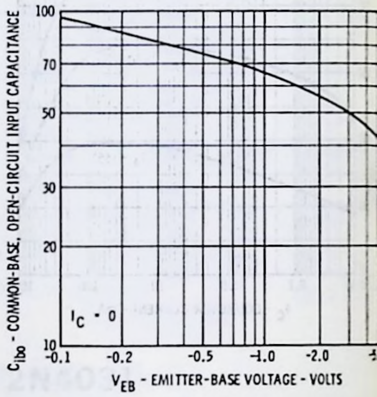
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



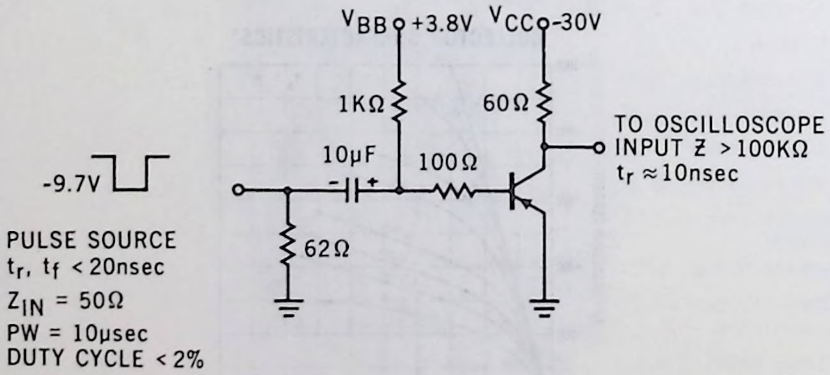
COMMON BASE OPEN CIRCUIT OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



COMMON BASE OPEN CIRCUIT INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



T_{on} AND T_{off} TEST CIRCUIT


V_{BB} +3.8V
V_{CC} -30V
1KΩ
60Ω
TO OSCILLOSCOPE
INPUT Z > 100KΩ
$t_r \approx 10$nsec
10µF
100Ω
-9.7V
62Ω
PULSE SOURCE
t_r, t_f < 20nsec
Z_{IN} = 50Ω
PW = 10µsec
DUTY CYCLE < 2%

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 43.7°C/Watt (derating factor of 22.8 mW/°C); junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

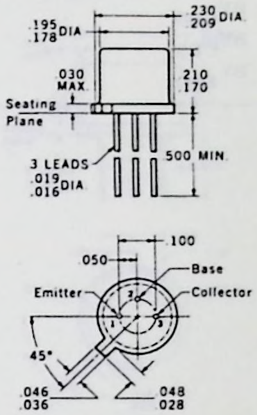
2N4034 • 2N4035

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The 2N4034 and 2N4035 are High-Gain Silicon PNP Transistors suitable for a wide range of applications including fast high-voltage switching, low noise, low-current requirements, and high-gain RF applications. Key performance parameters are: typical maximum available gain of 27 db at 100 Mc, low- and high-frequency noise figures of 3.5 db, and turn-on and turn-off times of 40 and 150 nsec respectively.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C
Lead Temperature (Soldering, 60 sec Time Limit)	300°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage		-40 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-40 Volts
V_{EBO}	Emitter to Base Voltage		-5.0 Volts
I_C	Collector Current		100 mA

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N4034			2N4035			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
h_{FE}	DC Current Gain	20	50		70	100			I_C = 10 μA V_{CE} = -1.0 V
h_{FE}	DC Current Gain	50	90		140	180			I_C = 100 μA V_{CE} = -1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	70	150	200	150	200	300		I_C = 10 mA V_{CE} = -1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	15	30		30	60			I_C = 50 mA V_{CE} = -1.0 V
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		-0.2	-0.3		-0.2	-0.3	Volts	I_C = 50 mA I_B = 5.0 mA
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		-0.1	-0.14		-0.1	-0.14	Volts	I_C = 10 mA I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage	-0.7	-0.77	-0.9	-0.7	-0.77	-0.9	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CEO}(sust)	Collector Emitter Sustaining Voltage (Notes 4 and 5)	-40			-40			Volts	I_C = 10 mA I_B = 0 (pulsed)
h_{fe}	High Frequency Current Gain (f = 100 Mc)	4.0	5.5		4.5	6.0			I_C = 10 mA V_{CE} = -20 V
C_{obo}	Output Capacitance		2.2	3.5		2.2	3.5	pf	I_E = 0 V_{CB} = -10 V
C_{ibo}	Input Capacitance		4.0	5.5		4.0	5.5	pf	I_C = 0 V_{EB} = -0.5 V
NF	Noise Figure (f = 100 Mc)		3.5	6.0		3.5	6.0	db	I_C = 1.0 mA V_{CE} = -5.0 V R_S = 100 Ω BW = 15 Mc
$r_b{}'c_c$	Collector Base Time Constant (f = 80 Mc)			40			40	psec	I_C = 10 mA V_{CE} = -20 V
t_{on}	Turn On Time (Note 6)		20	40		20	40	nsec	I_C ≈ 50 mA, I_{B1} ≈ 5.0 mA
t_{off}	Turn Off Time (Note 6)		95	150		95	150	nsec	I_C ≈ 50 mA, $I_{B1} \approx I_{B2} \approx$ 5.0 mA

OTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C); junction-to ambient thermal resistance of 500°C/Watt (derating factor of 2.06 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

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SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

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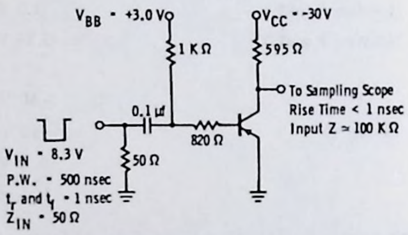
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N4034			2N4035				
Symbol	Characteristic	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Current Gain	60	100		150	200			I_C = 1.0 mA V_{CE} = -1.0 V
h_{FE}(-55°C)	Pulse Current Gain (Note 5)	30	60		70	100			I_C = 10 mA V_{CE} = -1.0 V
V_{CE}(sat)	Collector Saturation Voltage		-0.07	-0.13		-0.07	-0.13	Volts	I_C = 1.0 mA I_B = 0.1 mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, Note 5)		-0.88	-1.1		-0.88	-1.1	Volts	I_C = 50 mA I_B = 5.0 mA
V_{BE}(sat)	Base Saturation Voltage		-0.65	-0.75		-0.65	-0.75	Volts	I_C = 1.0 mA I_B = 0.1 mA
*I_{CES}	Collector Reverse Current			15			15	nA	V_{CE} = -30 V V_{BE} = 0
I_{CES}(+125°C)	Collector Reverse Current			15			15	μA	V_{CE} = -30 V V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-40			-40			Volts	I_C = 10 μA I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	-40			-40			Volts	I_C = 10 μA V_{BE} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0			-5.0			Volts	I_C = 0 I_E = 10 μA

SWITCHING TIME TEST CIRCUIT



SMALL SIGNAL CHARACTERISTICS (f = 1 Kc)

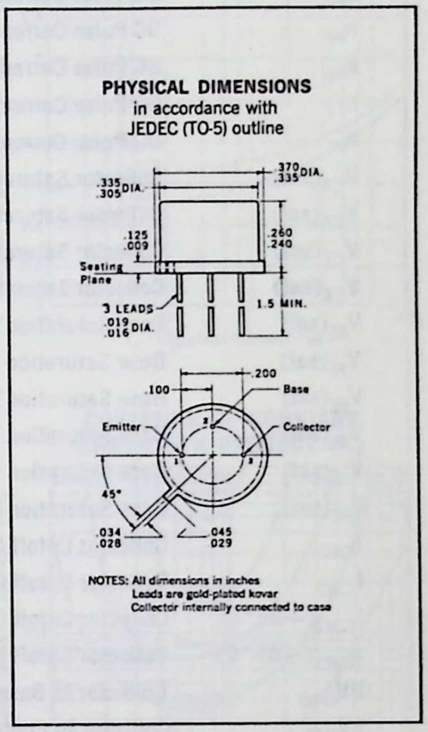
		2N4034		2N4035			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{ie}	Input Resistance	1.0	8.0	4.0	12	KΩ	I_C = 1.0 mA V_{CE} = 10 V
h_{oe}	Output Conductance	2.0	24	8.0	40	μmho	I_C = 1.0 mA V_{CE} = 10 V
h_{re}	Voltage Feedback Ratio		3.0		4.0	$\times 10^{-4}$	I_C = 1.0 mA V_{CE} = 10 V
h_{fe}	Forward Current Transfer Ratio	50	300	150	450		I_C = 1.0 mA V_{CE} = 10 V

2N4046 · 2N4047

NPN HIGH-VOLTAGE, HIGH-CURRENT SWITCHES

SILICON PLANAR* EPITAXIAL TRANSISTORS

HIGH SPEED . . . . $t_{on} = 35$ ns (MAX) AT 500 mA
. . . . $t_{off} = 65$ ns (MAX) AT 500 mA
HIGH VOLTAGE . . . . $LV_{CEO} = 30$ V (MIN) (2N4046) OR 50 V (MIN) (2N4047)
HIGH GAIN . . . . $h_{FE} = 30$ (MIN) AT 500 mA, 1.0 V
. . . . $h_{FE} = 25$ (MIN) AT 1.0, 5.0 V
LOW SATURATION VOLTAGE . . . $V_{CE}(sat) = 0.65$ V (MAX) AT 800 mA
. . . $V_{CE}(sat) = 0.75$ V (MAX) AT 1.0A


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline
.370
.335 DIA.
.335
.305 DIA.
.125
.009
.260
.240
Seating Plane
3 LEADS
.019
.016 DIA.
1.5 MIN.
.200
.100
Base
Emitter
Collector
45°
.034
.028
.045
.029
NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	+300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	3.5 Watts
at 25°C Ambient Temperature	0.8 Watt

Maximum Voltages and Current

		2N4046	2N4047
V_{CBO}	Collector to Base Voltage	50 Volts	80 Volts
V_{CES}	Collector to Emitter Voltage	50 Volts	80 Volts
V_{CEO}	**Collector to Emitter Voltage** (Note 4)	30 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	DC Collector Current	500 mA	500 mA

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N4046 MIN.	2N4046 TYP.	2N4046 MAX.	2N4047 MIN.	2N4047 TYP.	2N4047 MAX.	UNITS	TEST CONDITIONS
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage**	30			50			Volts	$I_C = 10$ mA (pulsed) $I_B = 0$
$V_{CE}(sat)$	**Collector Saturation Voltage** (Note 5)		0.5	0.75		0.6	0.95	Volts	$I_C = 1000$ mA(pulsed) $I_B = 100$ mA
$V_{CE}(sat)$	Collector Saturation Voltage (Note 5)		0.3	0.42		0.4	0.52	Volts	$I_C = 500$ mA (pulsed) $I_B = 50$ mA
t_{on}	**Turn-on Time** (Note 6)		18	35		18	35	ns	$I_C \approx 500$ mA $I_{B1} \approx 50$ mA
t_{off}	**Turn-off Time** (Note 6)		45	60		45	60	ns	$I_C \approx 500$ mA, $I_{B1} \approx 50$ mA $I_{B2} \approx -50$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5	4.5		2.5	4.5			$I_C = 50$ mA $V_{CE} = 10$ V
C_{obo}	Common Base, Open Circuit Output Capacitance		6.0	12		4.8	10	pF	$I_E = 0$ $V_{CB} = 10$ V
C_{ibo}	Common Base, Open Circuit Input Capacitance		40	55		40	55	pF	$I_C = 0$ $V_{EB} = 0.5$ V

*Planar is a patented Fairchild process.

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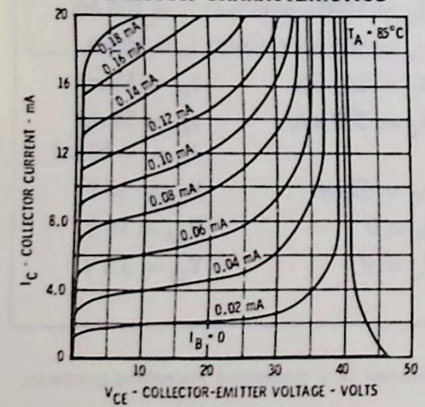
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

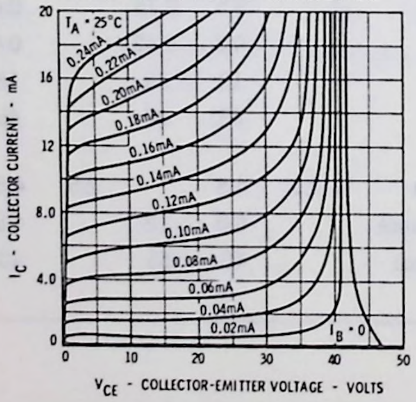
		2N4046			2N4047					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	90	150	40	90	150		$I_C = 100$ mA	$V_{CE} = 1.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	30	50		20	45			$I_C = 500$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	65		30	60			$I_C = 300$ mA	$V_{CE} = 1.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	25	65		15	65			$I_C = 1000$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	60		20	60			$I_C = 10$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	45		15	40			$I_C = 800$ mA	$V_{CE} = 2.0$ V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.11	0.25		0.19	0.25	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.13	0.2		0.21	0.26	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.22	0.32		0.31	0.4	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{CE}(sat)	**Collector Saturation Voltage** (Note 5)		0.4	0.65		0.5	0.8	Volts	$I_C = 800$ mA	$I_B = 80$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.64	0.76		0.64	0.76	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.75	0.86		0.75	0.86	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.89	1.1		0.89	1.1	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)	0.9	0.95	1.2	0.9	0.95	1.2	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.0	1.5		1.0	1.5	Volts	$I_C = 800$ mA	$I_B = 80$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.1	1.7		1.1	1.7	Volts	$I_C = 1000$ mA	$I_B = 100$ mA
I_{CBO}	Collector Cutoff Current		0.25	1.7				μA	$I_E = 0$	$V_{CB} = 40$ V
I_{CBO}	Collector Cutoff Current					0.33	1.7	μA	$I_E = 0$	$V_{CB} = 60$ V
I_{CBO}(+85°C)	Collector Cutoff Current		25	120				μA	$I_E = 0$	$V_{CB} = 40$ V
I_{CBO}(+85°C)	Collector Cutoff Current					25	120	μA	$I_E = 0$	$V_{CB} = 60$ V
BV_{CBO}	Collector to Base Breakdown Voltage	50			80			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	50			80			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 10$ μA

TYPICAL ELECTRICAL CHARACTERISTICS
2N4046

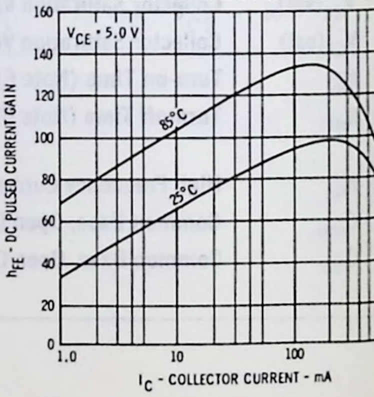
COLLECTOR CHARACTERISTICS



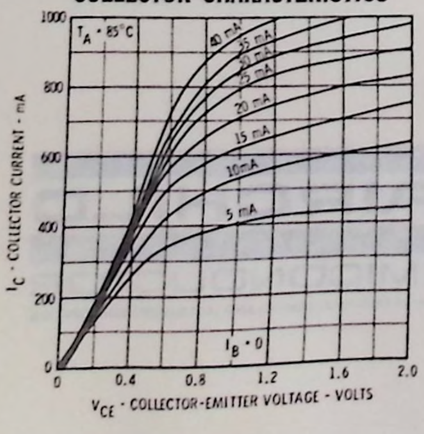
COLLECTOR CHARACTERISTICS



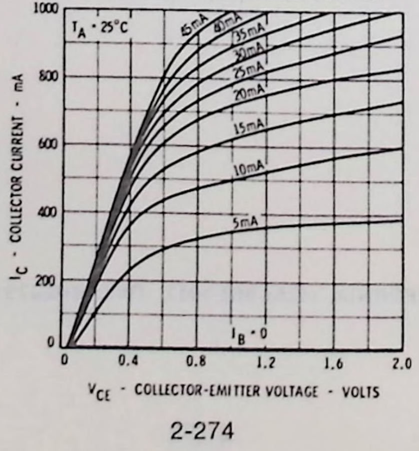
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURREN



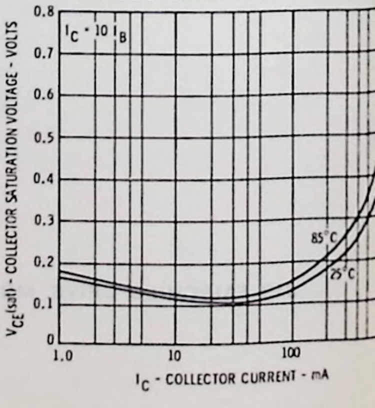
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



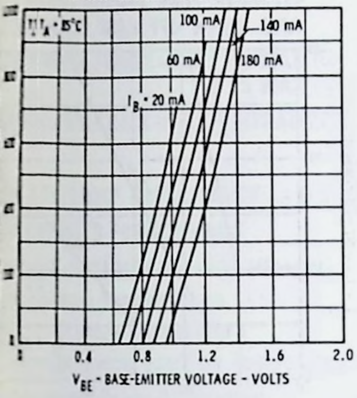
COLLECTOR SATURATION VOLTA VERSUS COLLECTOR CURREN



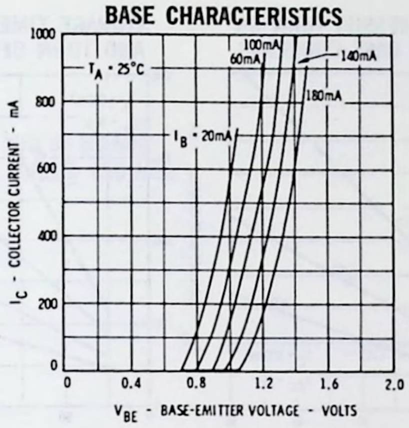
TYPICAL ELECTRICAL CHARACTERISTICS

2N4046 • 2N4047

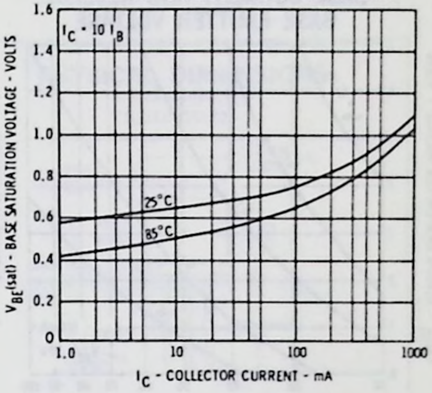
BASE CHARACTERISTICS



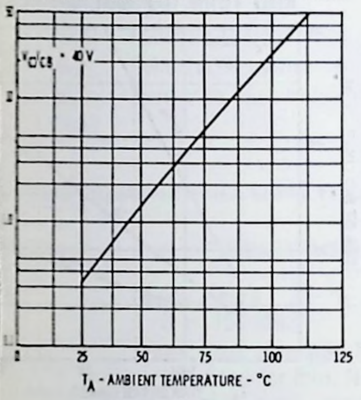
BASE CHARACTERISTICS



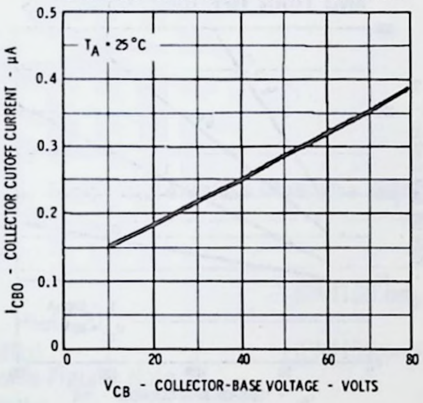
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



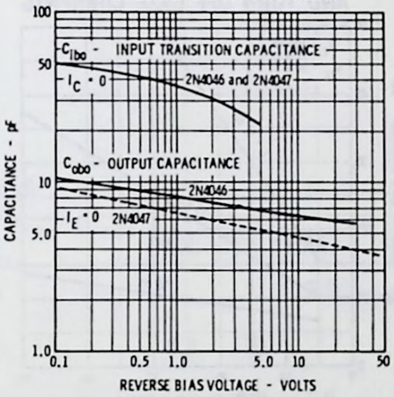
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



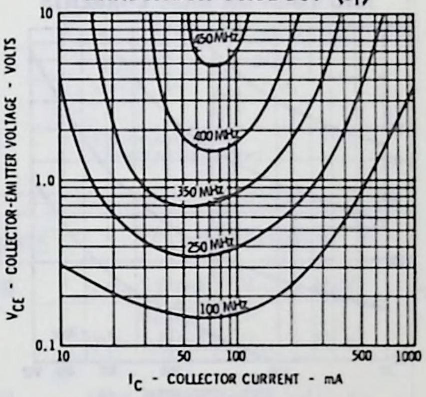
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

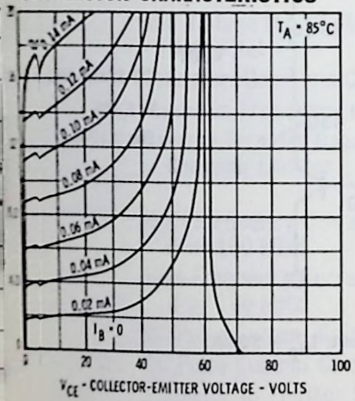


CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)

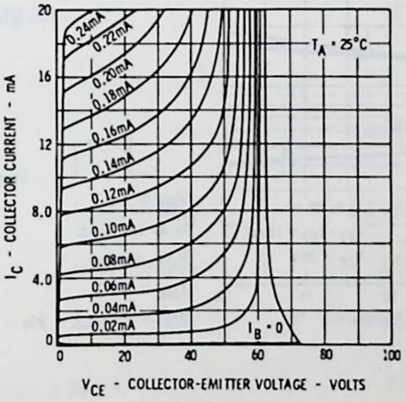


2N4047

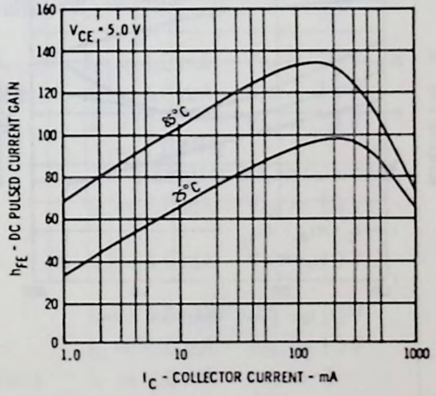
COLLECTOR CHARACTERISTICS



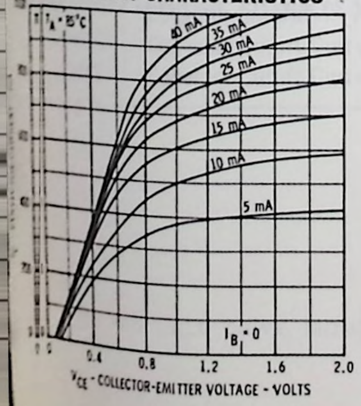
COLLECTOR CHARACTERISTICS



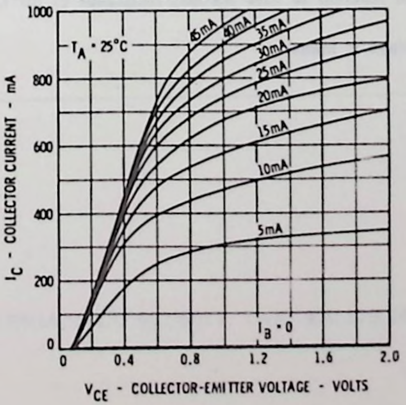
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



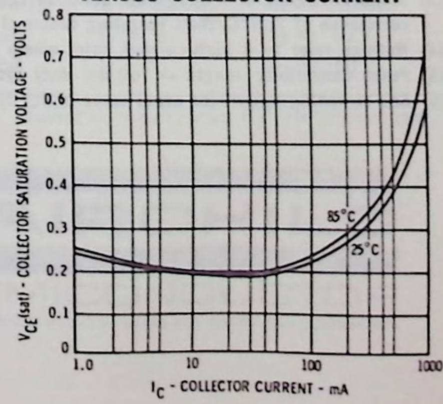
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



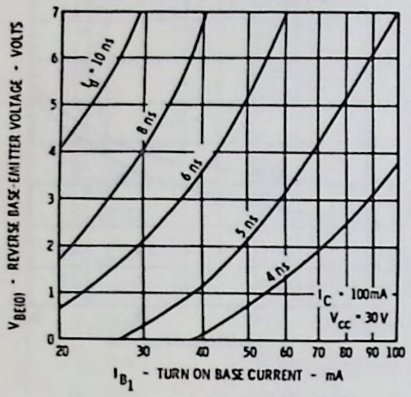
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



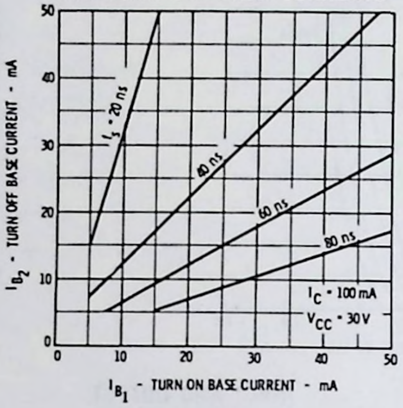
TYPICAL ELECTRICAL CHARACTERISTICS

2N4046 • 2N4047

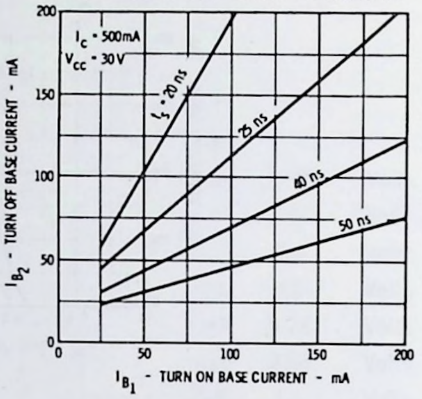
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



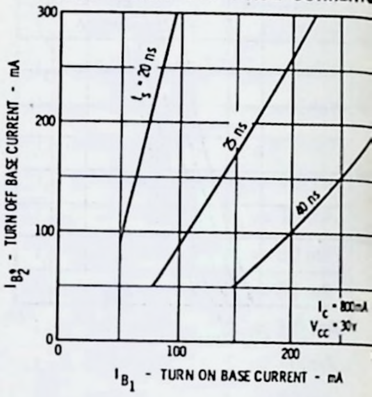
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



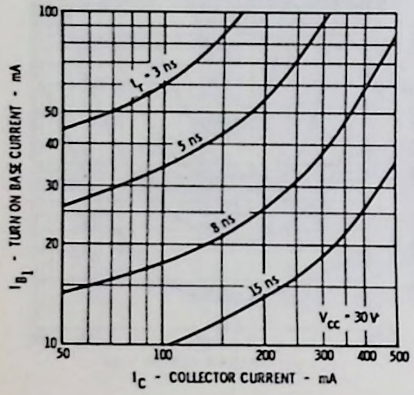
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



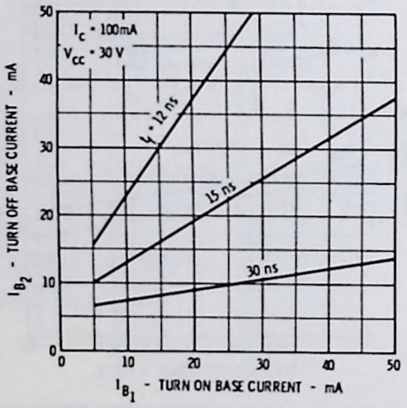
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



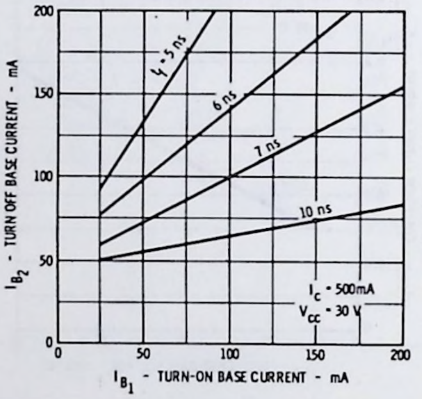
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



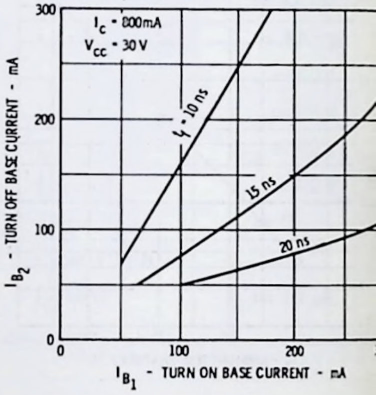
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



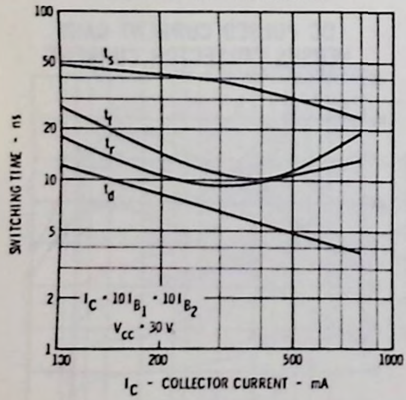
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



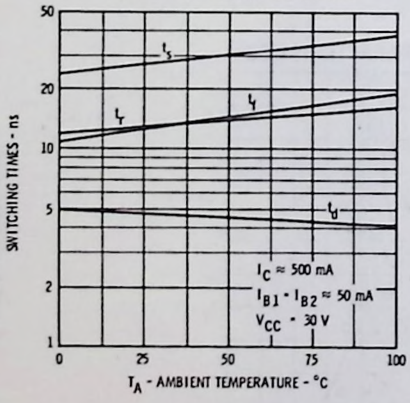
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



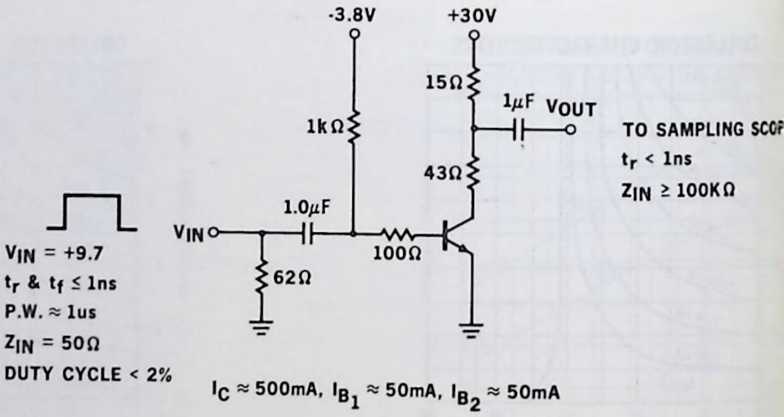
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



V_{IN} = +9.7

t_r & t_f ≤ 1ns

P.W. ≈ 1us

Z_{IN} = 50Ω

DUTY CYCLE < 2%

I_C ≈ 500mA, I_{B_1} ≈ 50mA, I_{B_2} ≈ 50mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C). Junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) Ratings refer to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) See switching circuit for exact value of I_C, I_{B1}, and I_{B2}.

2N4134 • 2N4135

NPN LOW NOISE RF AMPLIFIERS

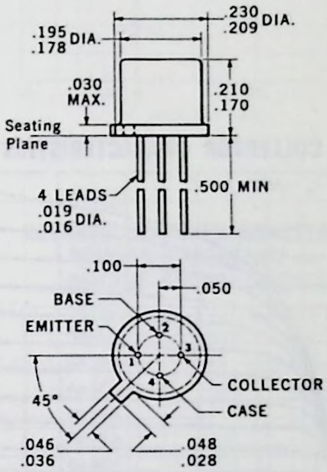
DIFFUSED SILICON PLANAR* TRANSISTORS

- **LOW NOISE FIGURE -- 2.5 db MAX @ 60 MHz**
  5.0 db MAX @ 450 MHz
- **HIGH STABLE GAIN IN UNNEUTRALIZED AMPLIFIERS -- 20 db MIN @ 60 MHz**
  8 db MIN @ 450 MHz
- **LOW FEEDBACK CAPACITANCE -- 0.5 pF MAX**
- **GUARANTEED FORWARD AGC**

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−55°C to +200°C
Operating Junction Temperature	+200°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Note 2]	0.3 Watt
at 25°C Ambient Temperature [Note 2]	0.2 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	30 Volts
V_{CEO} Collector to Emitter Voltage [Note 3]	30 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-72)



NOTES: All dimensions in inches
Leads are gold-plated kovar

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

SYMBOL	CHARACTERISTIC		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	**Noise Figure (f = 450 MHz) [Note 5]**	(2N4135 only)			5.0	dB	$I_E = 1.0$ mA $V_{CB} = 15$ V $R_S \approx 130\ \Omega$
PG	**Power Gain (f = 450 MHz)** (Adjusted for min. Noise Figure; Note 5)	(2N4135 only)	8.0	10			$I_E = 1.0$ mA $V_{CB} = 15$ V
NF	**Noise Figure (f = 60 MHz)** [Note 6]			2.0	2.5	dB	$I_E = 1.0$ mA $V_{CB} = 15$ V $R_S \approx 300\ \Omega$
PG	**Power Gain, Neutralized (f = 60 MHz)** (Adjusted for min. Noise Figure; Note 6)		17	21	24	dB	$I_E = 1.0$ mA $V_{CB} = 15$ V
PG	**Power Gain, Unneutralized (f = 60 MHz)** [Note 7]		20	23	25	dB	$I_E = 5.0$ mA $V_{AGC} = 13$ V
V_{AGC}	**AGC Voltage for 30 db Gain Reduction (f = 60 MHz)** [Note 7]		19	22	24.5	Volts	$V_{CC} = 28$ V
$r_b'C_c$	Collector-Base Time Constant (f = 80 MHz)			2.5	5.0	ps	$I_C = 4.0$ mA $V_{CE} = 10$ V
f_{max}	Maximum Frequency of Oscillation			3.25		GHz	$I_E = 4.0$ mA $V_{CB} = 15$ V
C_{re}	**Reverse Transfer Capacity Common Emitter**		0.25	0.37	0.50	pF	$I_E = 0$ $V_{CE} = 10$ V f = 1.0 MHz (Emitter & Can Guarded)
h_{fe}	High Frequency Current Gain (f = 100 MHz)	(2N4135 only)	4.25		8.0		$I_C = 4.0$ mA $V_{CE} = 10$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	(2N4134 only)	3.5		8.0		$I_C = 4.0$ mA $V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 4]		25		200		$I_C = 4.0$ mA $V_{CE} = 10$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 4]		10				$I_C = 4.0$ mA $V_{CE} = 10$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 3 and 4]		30			Volts	$I_C = 1.0$ mA $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage		30			Volts	$I_C = 1.0$ mA $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage		3.0			Volts	$I_C = 0$ $I_E = 100\ \mu$A
V_{BE} (sat)	Base Saturation Voltage				0.92	Volt	$I_C = 10$ mA $I_B = 5.0$ mA
V_{CE} (sat)	Collector Saturation Voltage				3.0	Volts	$I_C = 10$ mA $I_B = 5.0$ mA
I_{CBO} (150°C)	Collector Cutoff Current				50	μA	$I_E = 0$ $V_{CB} = 10$ V
I_{CBO} (25°C)	Collector Cutoff Current				50	nA	$I_E = 0$ $V_{CB} = 10$ V

* Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 583°C/Watt (derating factor 1.72 mW/°C); junction to ambient thermal resistance of 875°C/Watt (derating factor of 1.14 mW/°C).

(3) Rating refers to a high-current point where collector to emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(5) Test conditions are as shown in Figure 1. Noise Figure referenced to AIL type 70 Hot-Cold noise standard. Noise Figure includes second stage contribution of 5.0 db.

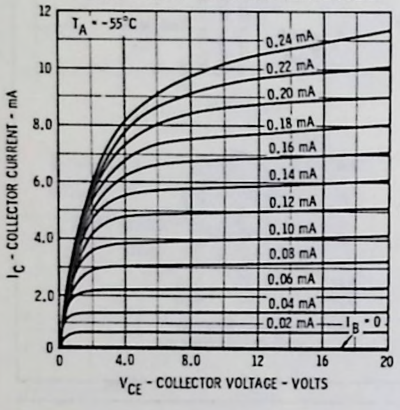
(6) Test conditions are as shown in Figure 2. Amplifier Gain is measured with amplifier input tuned for minimum noise figure. Neutralization is used to minimize input bandpass skewing. With neutralization network removed, amplifier gain will be 2 to 3 db lower, but noise figure will not change measurably.

(7) Test conditions are as shown in Figure 3.

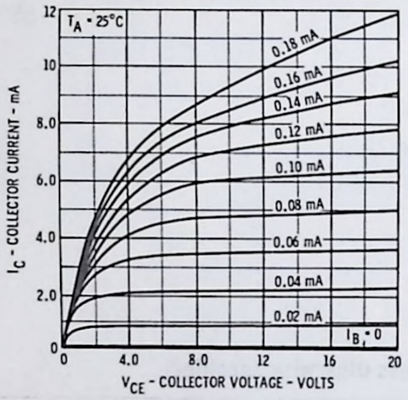
(8) Socket Capacitance is typically 0.5 pF and will degrade amplifier gain and stability. Best performance is obtained by omitting sockets and soldering or clipping transistor to the ground plane. If a socket is required, a shield should be used between the base and collector socket pins.

TYPICAL ELECTRICAL CHARACTERISTICS

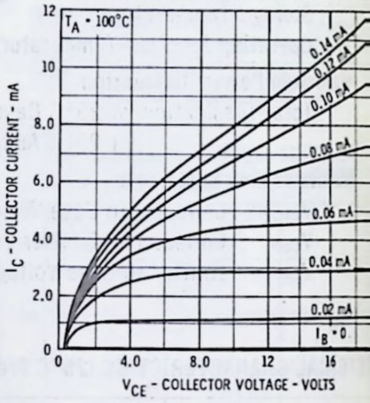
COLLECTOR CHARACTERISTICS*



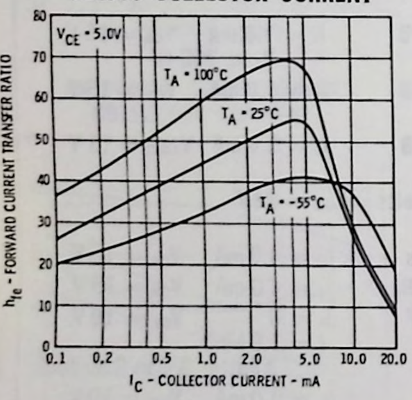
COLLECTOR CHARACTERISTICS*



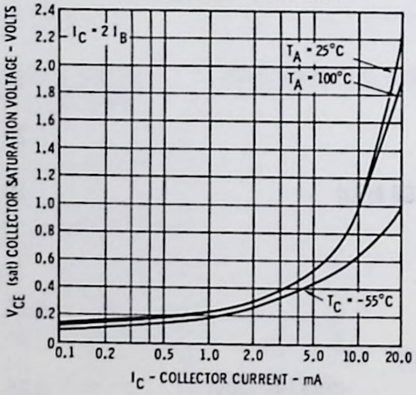
COLLECTOR CHARACTERISTICS



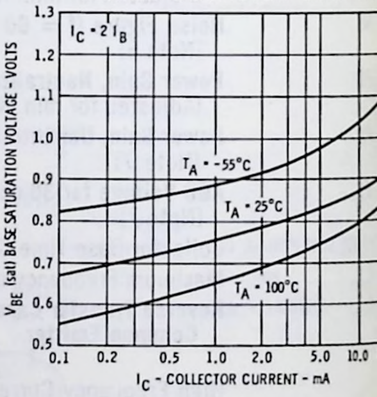
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



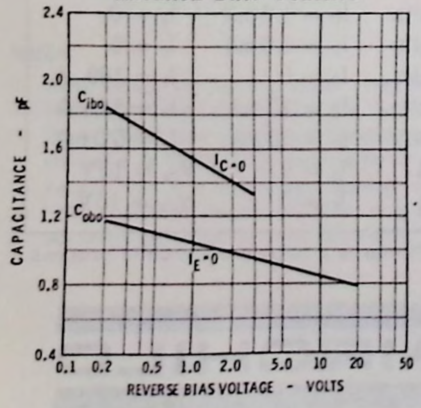
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



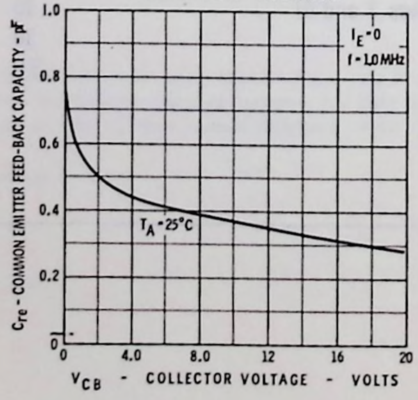
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



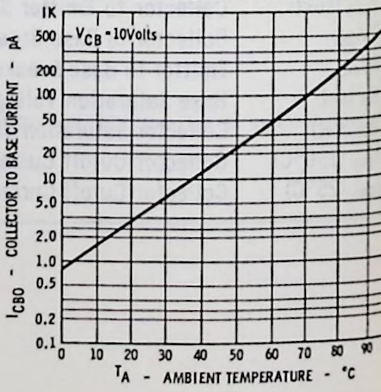
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



COMMON EMITTER FEED-BACK CAPACITY VERSUS COLLECTOR VOLTAGE

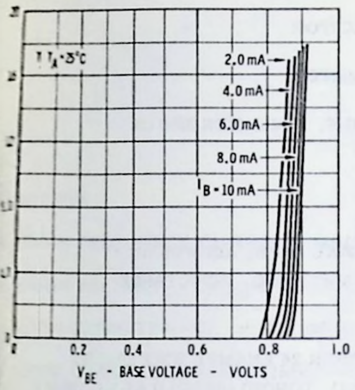


COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE

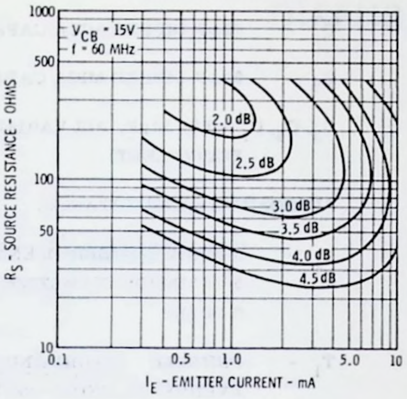


* Single family characteristic on Transistor Curve Tracer.

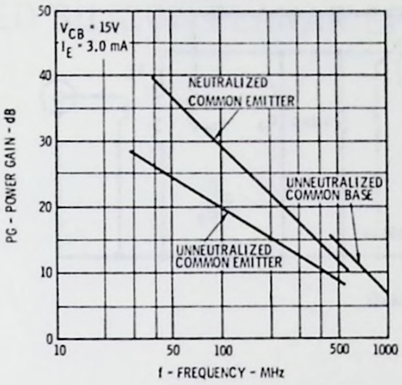
BASE CHARACTERISTICS*



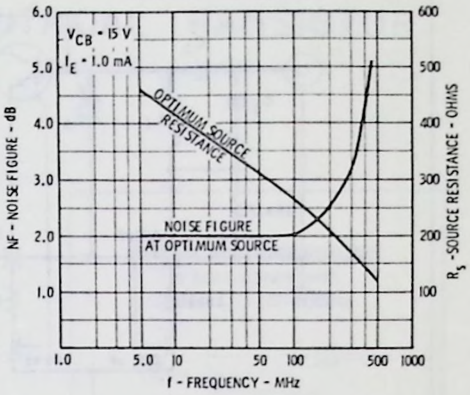
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT*



POWER GAIN VERSUS FREQUENCY

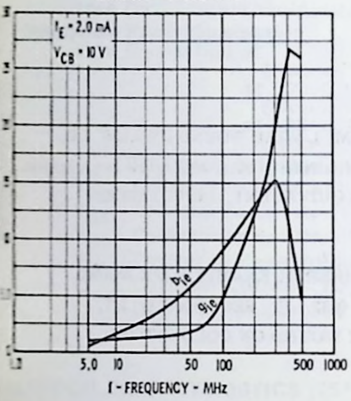


NOISE FIGURE AND SOURCE RESISTANCE VERSUS FREQUENCY

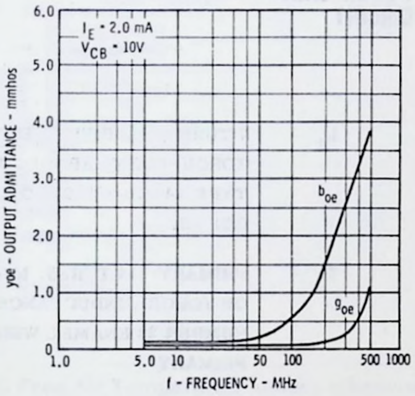


TYPICAL "Y" PARAMETERS

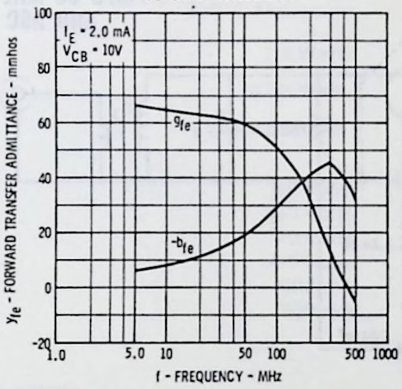
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



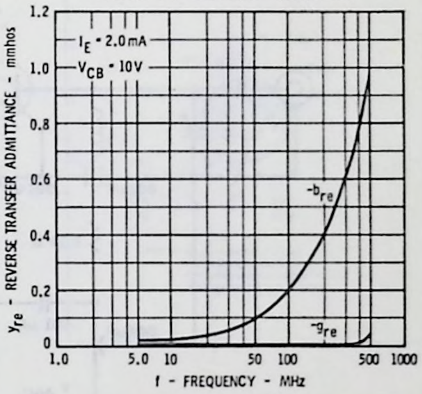
OUTPUT ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



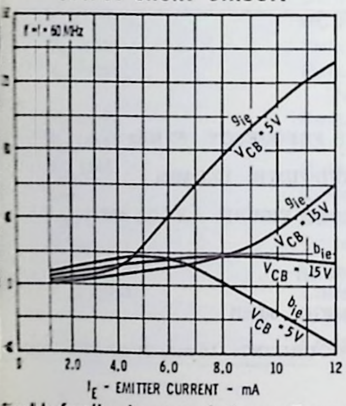
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



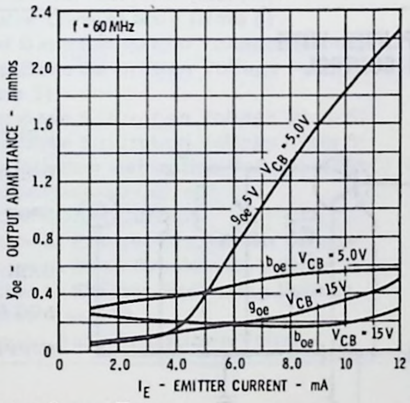
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



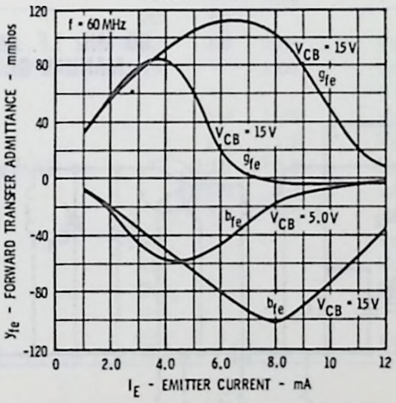
INPUT ADMITTANCE VERSUS EMITTER CURRENT — OUTPUT SHORT CIRCUIT



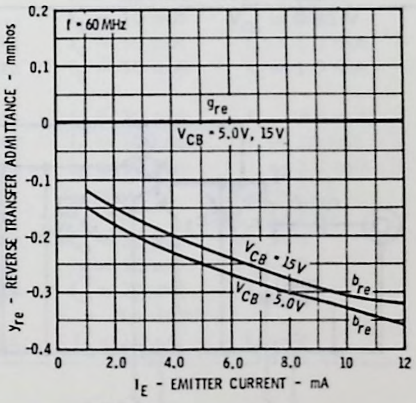
OUTPUT ADMITTANCE VERSUS EMITTER CURRENT — INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS EMITTER CURRENT — OUTPUT SHORT CIRCUIT



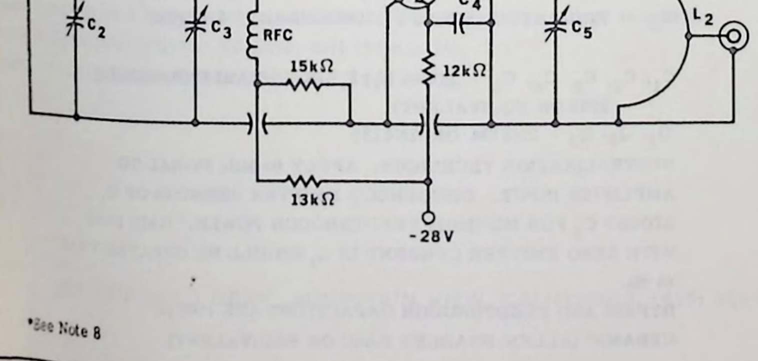
REVERSE TRANSFER ADMITTANCE VERSUS EMITTER CURRENT — INPUT SHORT CIRCUIT



*Single family characteristic on Transistor Curve Tracer.

FIG. 1 450 MHz NOISE FIGURE AND POWER GAIN CIRCUIT

(2N4135 only)



L_1 - C_1 300 pF, PORCELAIN CAPACITOR: CAPACITOR LEADS FORM L_1; LEAD DIAMETER 0.025, LENGTH 1-3/8" FROM INPUT CONNECTOR TO BASE PIN OF TRANSISTOR (VITRAMON VY 12C301 OR EQUIVALENT)

L_2 - 1 TURN, #22 TINNED WIRE 1/2" DIAMETER, 5/16" LONG, CENTER TAP

C_2, C_3, C_5 0.8 - 10 pF, AIR VARIABLE (JOHANSEN 2950 OR EQUIVALENT)

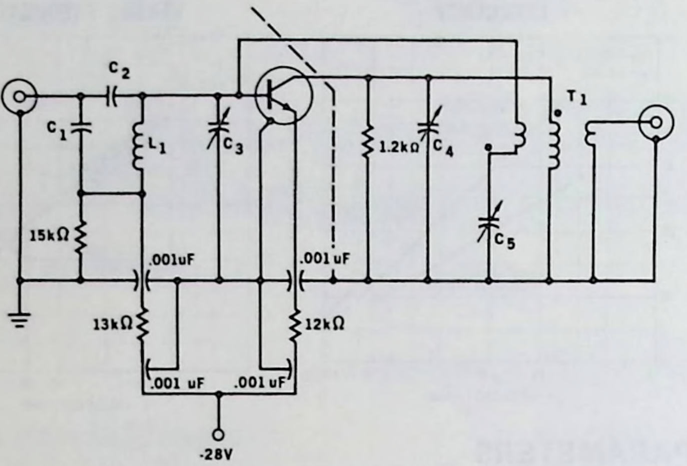
C_4 500 pF, UNCASED CERAMIC (CENTRALAB DA121 OR EQUIVALENT)

RFC 6" #30 ENAMEL WIRE, CLOSE WOUND, 1/16" DIAMETER

FEEDTHROUGH CAPACITORS ARE 1000 pF CERAMIC (ALLEN-BRADLEY FASC OR EQUIVALENT)

*See Note 8

FIG. 2 60 MHz NOISE FIGURE AND POWER GAIN CIRCUIT


C2
C1
L1
C3
1.2kΩ
C4
T1
C5
15kΩ
.001uF
.001 uF
13kΩ
12kΩ
.001 uF
.001 uF
-28V

C_1 - 62 pF DIPPED MICA CAPACITOR

C_2 - 51 pF DIPPED MICA CAPACITOR

C_3, C_4, C_5 - 0.8 - 10 pF, AIR VARIABLE, (JOHANSEN 2950 OR EQUIVALENT)

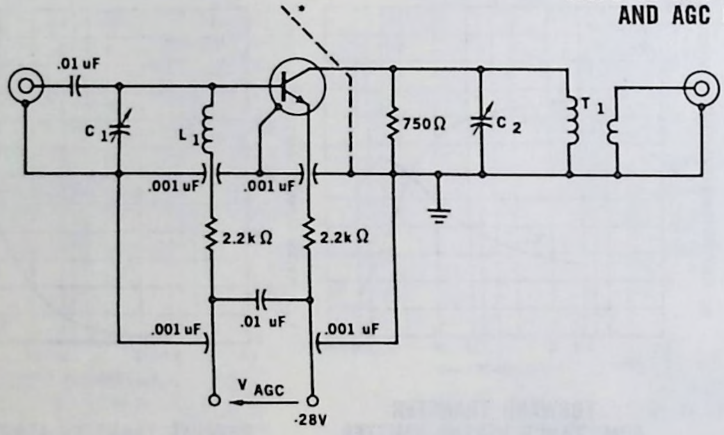
APPROXIMATE CAPACITANCE,

L_1 - 5 TURNS NUMBER 18 ENAMEL WIRE, AIR WOUND, 5/16" INSIDE DIAMETER, 3/8" LONG, INDUCTANCE 0.14 μH.

T_1 - PRIMARY: 14 TURNS NUMBER 24 ENAMEL WIRE SPACED EVENLY AROUND 0.156" I. D. TOROID (ARNOLD A4-310-125SF OR EQUIVALENT) INDUCTANCE 0.82 μH, SECONDARY: 3 TURNS, NEUTRALIZATION WINDING: 3 T CLOSE WOUND

BYPASS AND FEEDTHROUGH CAPACITORS ARE 1000 pF CERAMIC (ALLEN-BRADLEY FASC OR EQUIVALENT)

FIG. 3 60 MHz POWER GAIN AND AGC CIRCUIT


*
.01 uF
C1
L1
750Ω
C2
T1
.001 uF
.001 uF
2.2kΩ
2.2kΩ
.001 uF
.01 uF
.001 uF
V AGC
-28V

*See Note 8

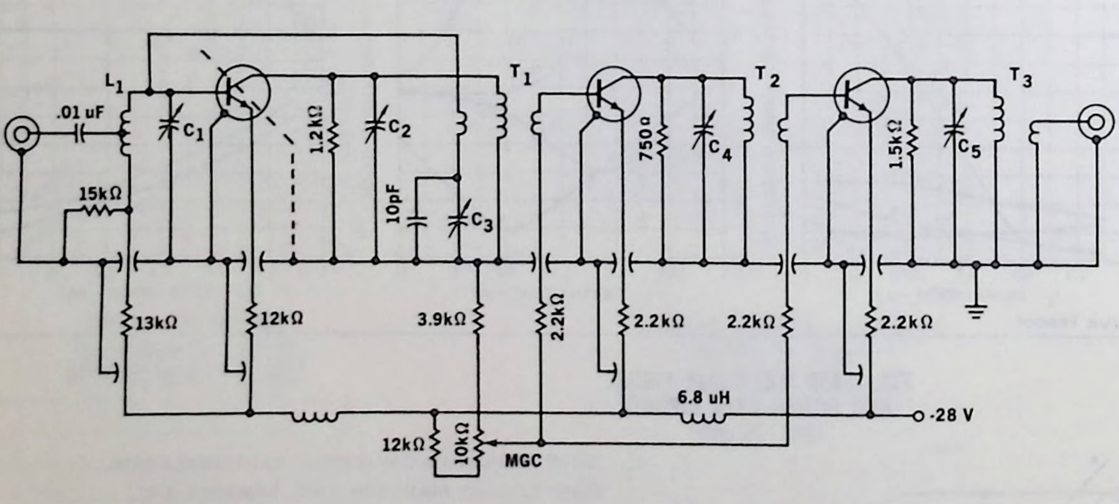
L_1 - 7 TURNS, NUMBER 22 ENAMEL WIRE WOUND ON 0.156" I.D. TOROID FORM, ARNOLD ENGINEERING COMPANY, TYPE A4-310-125-SF, OR EQUIVALENT, INDUCTANCE 0.21 μH.

T_1 - PRIMARY: 14 TURNS, NUMBER 24 ENAMEL WIRE WOUND ON TOROID, INDUCTANCE 0.82 μH. SECONDARY: 3 T, NUMBER 22 ENAMEL WIRE WOUND ON COLD END OF PRIMARY

C_1, C_2 - 0.8 - 10 pF, AIR VARIABLE, (JOHANSEN 2950 OR EQUIVALENT)

BYPASS AND FEEDTRHOUGH CAPACITOR ARE 1000 pF CERAMIC (ALLEN-BRADLEY FASC OR EQUIVALENT)

60 MHz I.F. AMPLIFIER WITH MANUAL GAIN CONTROL


L1
.01 uF
C1
15kΩ
1.2kΩ
C2
T1
10pF
C3
750Ω
C4
T2
1.5kΩ
C5
T3
13kΩ
12kΩ
3.9kΩ
2.2kΩ
2.2kΩ
2.2kΩ
2.2kΩ
6.8 uH
-28 V
12kΩ
10kΩ
MGC

CENTER FREQUENCY: 60 MHz

3 dB BANDWIDTH: 10.5 MHz

SPOT NOISE FIGURE: 1.8 ± 0.1 dB

GAIN: 62 dB

AGC RANGE: 60 dB

SUPPLY CURRENT: 15 mA; 21 mA @ 60 dB AGC

L_1 - 15 TURNS NUMBER 30 ENAMEL WIRE, CENTER TAPPED, WOUND ON 0.156" I. D. TOROID (MICROMETALS T30-13 OR EQUIVALENT) INDUCTANCE 0.32 μH

T_1 - PRIMARY 14 TURNS NUMBER 24 ENAMEL WIRE SPACED EVENLY AROUND 0.156" I. D. TOROID (ARNOLD A4-310-125SF OR EQUIVALENT) INDUCTANCE 0.82 μH
SECONDARY: 1 TURN, NEUTRALIZATION WINDING: 1 TURN

T_2 - AS T_1 WITHOUT NEUTRALIZATION WINDING

T_3 - PRIMARY: SAME AS T_1, SECONDARY: 3 TURNS

C_1, C_2, C_3, C_4, C_5 - 0.8 to 10 pF AIR VARIABLE (JOHANSEN 2950 OR EQUIVALENT)

Q_1, Q_2, Q_3 - 2N4134 OR 2N4135

NEUTRALIZATION TECHNIQUE: APPLY 60 MHz SIGNAL TO AMPLIFIER INPUT. DISCONNECT EMITTER RESISTOR OF Q_1. ADJUST C_3 FOR MINIMUM FEEDTHROUGH POWER. GAIN LOSS WITH ZERO EMITTER CURRENT IN Q_1 SHOULD BE GREATER THAN 45 dB.

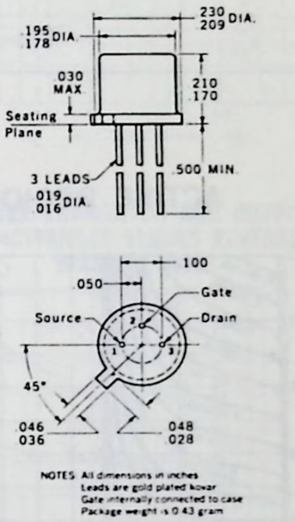
BYPASS AND FEEDTHROUGH CAPACITORS ARE 1000 pF CERAMIC (ALLEN-BRADLEY FASC OR EQUIVALENT).

2N4137
NPN HIGH-SPEED SATURATED SWITCH
DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

FEATURES

- **HIGH FREQUENCY CURRENT GAIN -- $f_T = 500$ MHz Min.**
- **HIGH VOLTAGE -- $LV_{CEO} = 20$ VOLT Min.**
- **LOW CAPACITY -- $C_{obo} = 4.0$ pf Max.**
- **LOW CHARGE STORAGE TIME -- $\tau_s = 13$ ns Max.**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Gate internally connected to case
Package weight is 0.43 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.2 Watts
at 100°C Case Temperature [Notes 2 and 3]	0.68 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.36 Watt
Maximum Voltages and Currents	
V_{CBO} Collector to Base Voltage	40 Volts
V_{CES} Collector to Emitter Voltage	40 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	20 Volts
V_{EBO} Emitter to Base Voltage	4.5 Volts
I_C Collector Current (10 μsec Pulse)	500 mA
I_C DC Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	40	66	120		$I_C = 10$ mA	$V_{CE} = 1.0$ V
h_{FE} (−55°C)	**DC Pulse Current Gain [Note 5]**	**20**	**50**			$I_C = 10$ mA	$V_{CE} = 0.35$ V
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	0.72	0.8	0.85	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Pulsed Base Saturation Voltage (−55°C to +125°C) [Note 5]	0.59		1.02	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		0.9	1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		1.1	1.6	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{CE} (sat)	**Pulse Collector Saturation Voltage (125°C)** [Note 5]		**0.19**	**0.3**	**Volts**	$I_C = 10$ mA	$I_B = 1.0$ mA
I_{CES}	Collector Reverse Current		0.05	0.4	μA	$V_{BE} = 0$	$V_{CE} = 20$ V
I_{CBO} (150°C)	Collector Cutoff Current		10	30	μA	$I_E = 0$	$V_{CB} = 20$ V
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	$I_C = 10$ μA	$I_E = 0$
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	**20**			**Volts**	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			Volts	$I_E = 10$ μA	$I_C = 0$

NOTES:

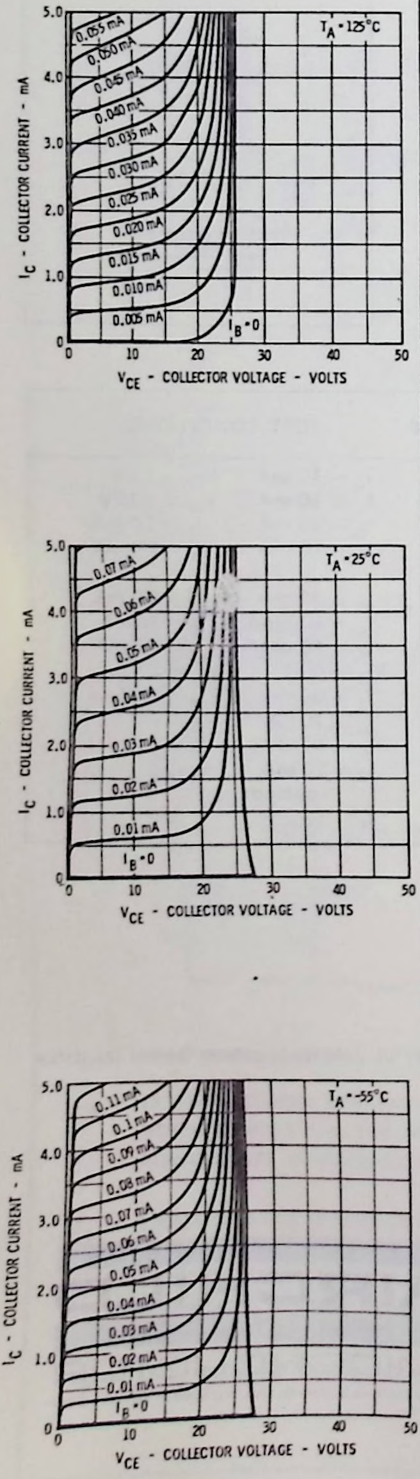
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C). Junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).
(4) Ratings refer to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) See switching circuits for exact value of I_C, I_{B1}, and I_{B2}.

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

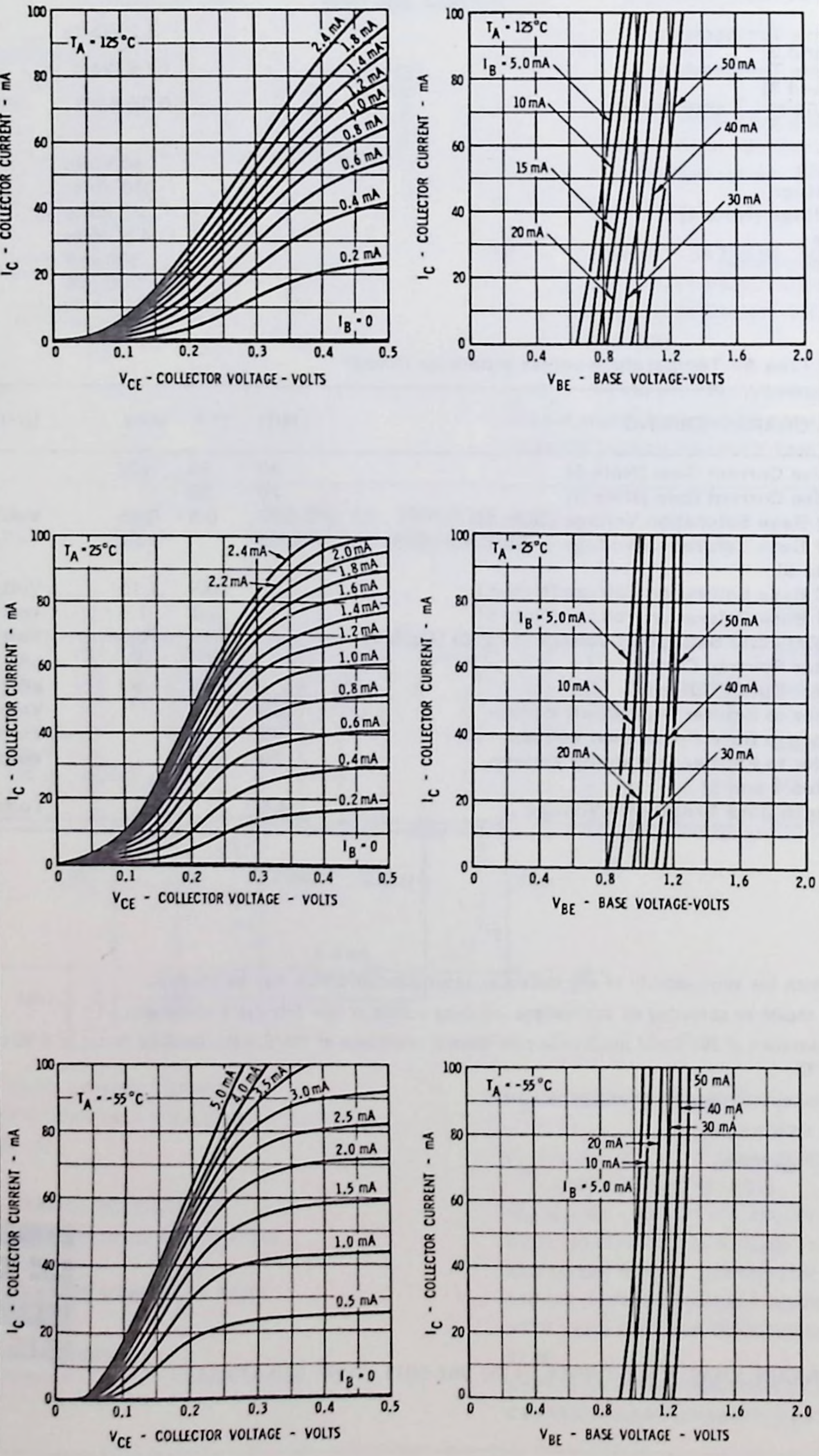
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	**DC Pulse Current Gain** [Note 5]	40	63	120		$I_C = 10$ mA $V_{CE} = 0.35$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	71			$I_C = 30$ mA $V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain [Note 5]	20				$I_C = 100$ mA $V_{CE} = 1.0$ V
V_{CE} (sat)	**Pulsed Collector Saturation Voltage** [Note 5]		0.14	0.2	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.12	0.18	Volts	$I_C = 10$ mA $I_B = 3.3$ mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.17	0.25	Volts	$I_C = 30$ mA $I_B = 3.0$ mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.28	0.5	Volts	$I_C = 100$ mA $I_B = 10$ mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	0.74	0.85	1.0	Volts	$I_C = 10$ mA $I_B = 3.3$ mA
h_{fe}	**High Frequency Current Gain (f = 100 mc)**	5.0	6.75			$I_C = 10$ mA $V_{CE} = 10$ V
C_{ob}	**Output Capacitance**		2.3	4.0	pf	$I_E = 0$ $V_{CB} = 5.0$ V
τ_S	**Charge Storage Time Constant** [Note 6]		6.0	13	nsec	$I_C = I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA
t_{on}	Turn On Time [Note 6]		9.0	12	nsec	$I_C \approx 10$ mA $I_{B1} \approx 3.3$ mA
t_{off}	Turn Off Time [Note 6]		7.0	12	nsec	$I_C \approx 10$ mA, $I_{B1} \approx 3.3$ mA, $I_{B2} \approx -3.3$ mA

TYPICAL COLLECTOR AND BASE CHARACTERISTICS

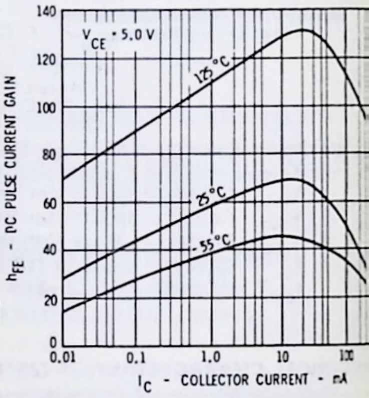
ACTIVE REGION



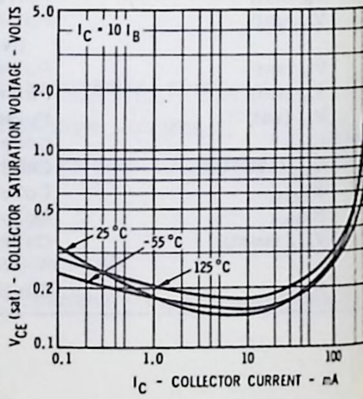
SATURATION REGION



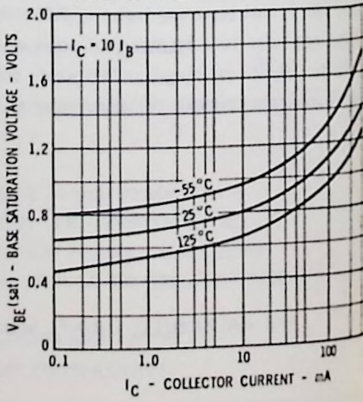
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

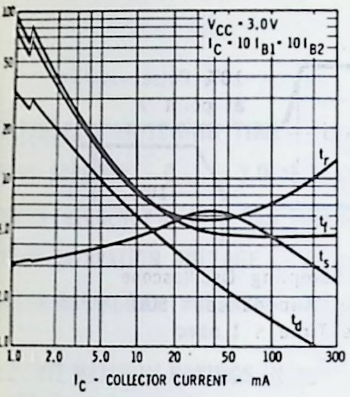


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

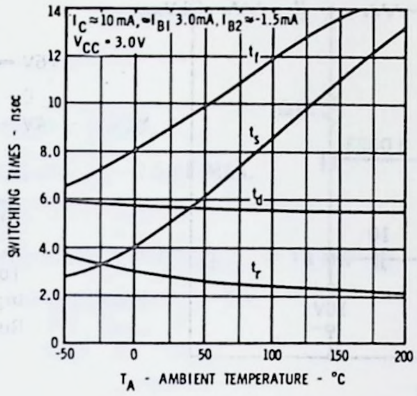


TYPICAL ELECTRICAL CHARACTERISTICS

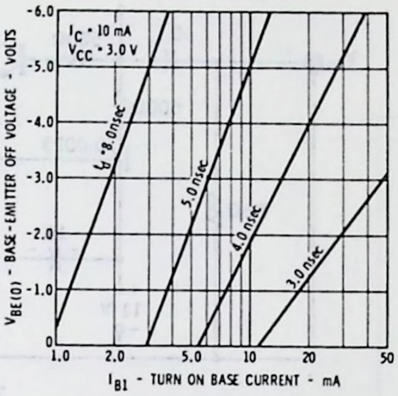
SWITCHING TIMES VERSUS COLLECTOR CURRENT



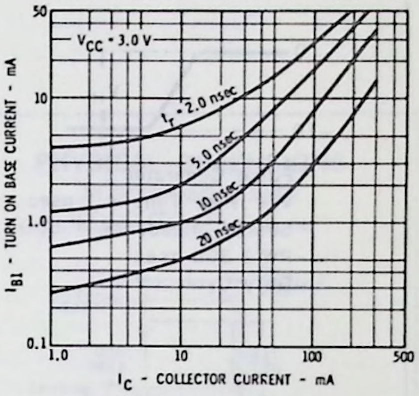
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



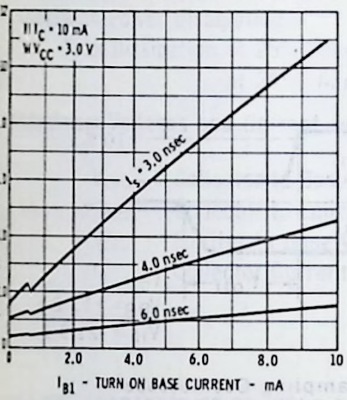
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



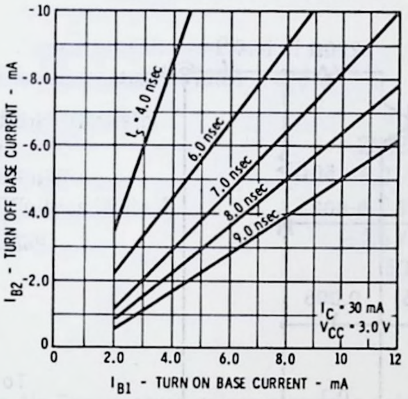
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



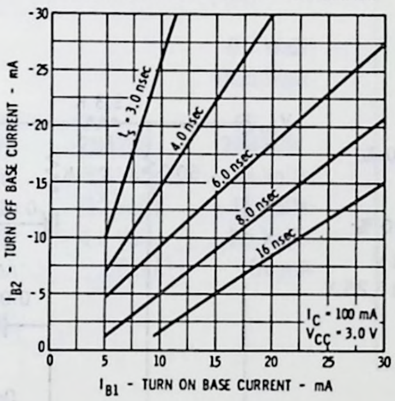
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



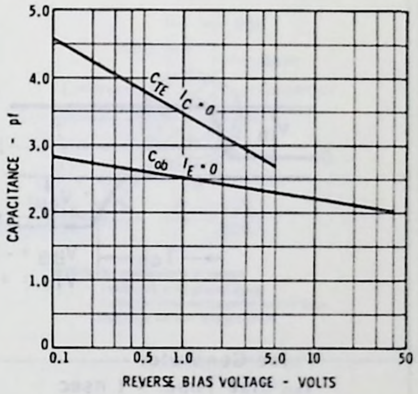
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



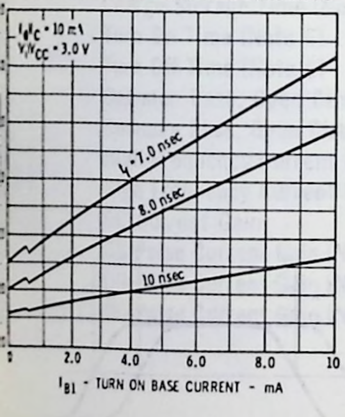
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



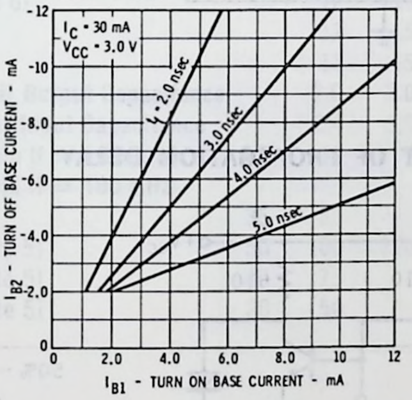
EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



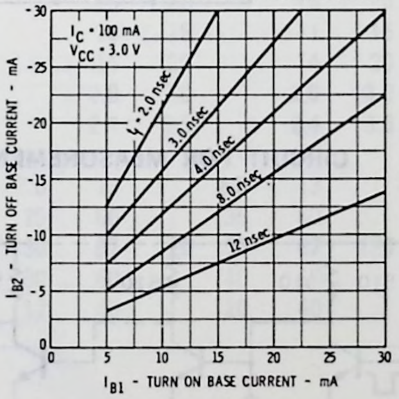
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



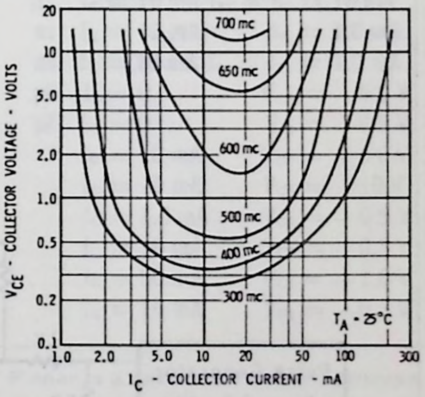
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



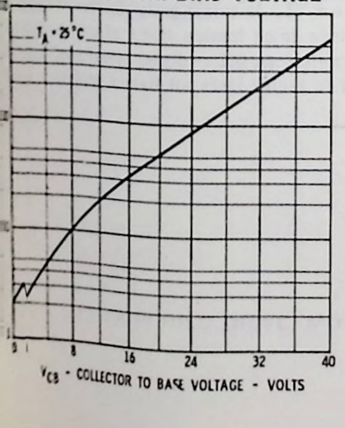
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



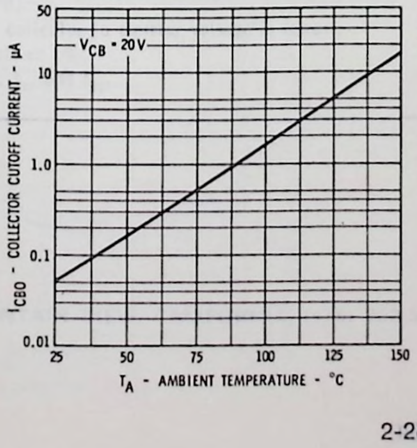
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



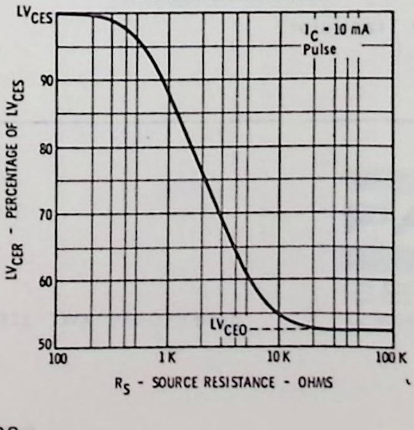
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



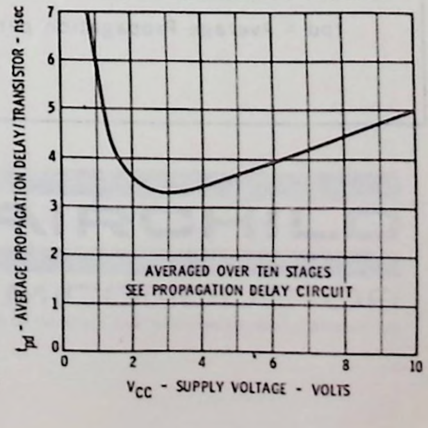
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



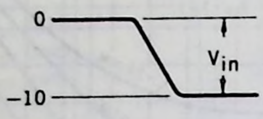
LOWER LIMITING VOLTAGE VERSUS SOURCE RESISTANCE



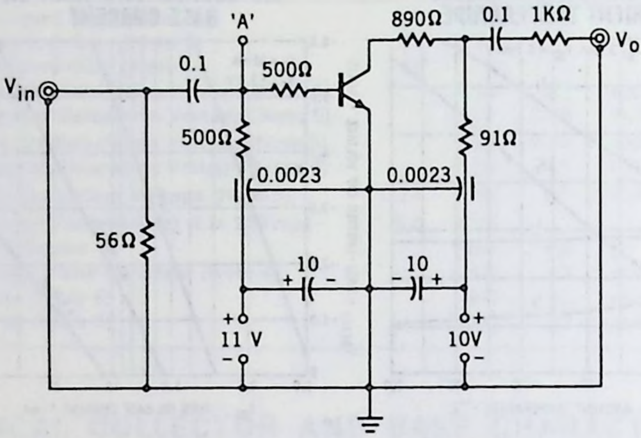
AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

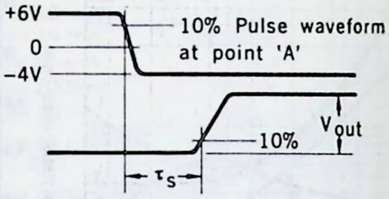


CHARGE STORAGE TIME MEASUREMENT CIRCUIT



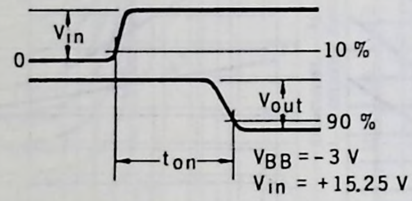
Pulse Generator
V_{in} Rise Time < 1 nsec
Source Impedance = 50Ω
PW ≥ 300 nsec
Duty Cycle < 2 %


'A'
V_{in}
0.1
500Ω
500Ω
56Ω
890Ω
0.1
1KΩ
V_{out}
91Ω
0.0023
0.0023
10
+ −
10
− +
+
11 V
−
+
10V
−

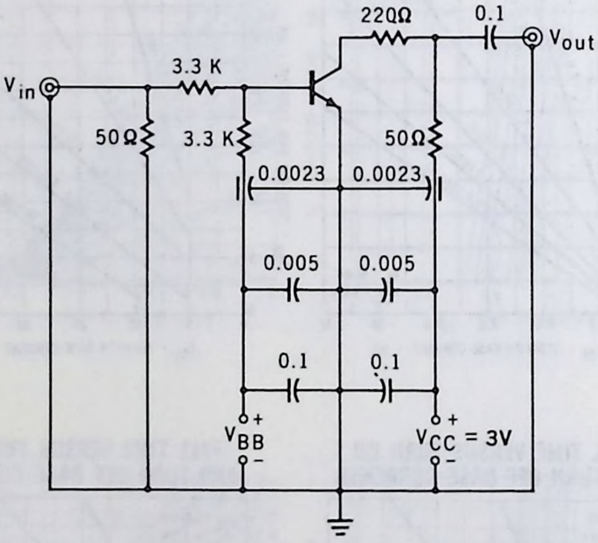

+6V
0
−4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_s

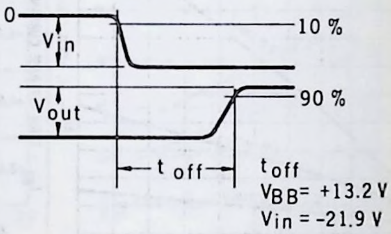
To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 nsec

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT


V_{in}
0
10 %
V_{out}
90 %
t_{on}
V_{BB} = −3 V
V_{in} = +15.25 V

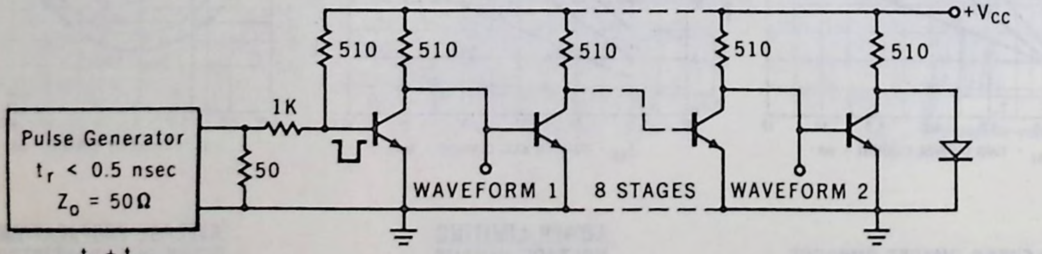
Pulse Generator
V_{in} Rise Time < 1 nsec
Source Impedance = 50Ω
PW ≥ 300 nsec
Duty Cycle < 2 %

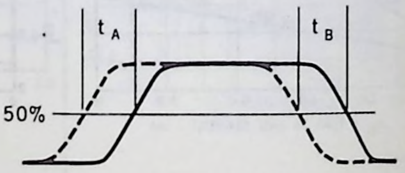

V_{in}
3.3 K
50Ω
3.3 K
220Ω
0.1
V_{out}
50Ω
0.0023
0.0023
0.005
0.005
0.1
0.1
+
V_{BB}
−
+
V_{CC} = 3V
−


0
V_{in}
10 %
V_{out}
90 %
t_{off}
t_{off}
V_{BB} = +13.2 V
V_{in} = −21.9 V

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 nsec

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY


+V_{CC}
510
510
510
510
510
1K
50
Pulse Generator
t_r < 0.5 nsec
Z_0 = 50Ω
WAVEFORM 1
8 STAGES
WAVEFORM 2



Waveforms 1 and 2 Superimposed

$$\bar{t}pd = \frac{t_A + t_B}{20}$$

$\bar{t}pd$ = Average Propagation per Transistor

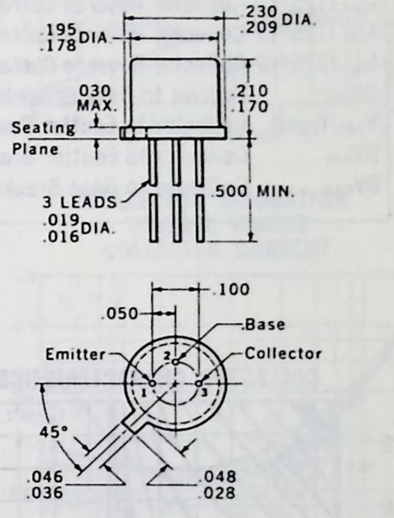
2N4207 • 2N4208 • 2N4209

PNP ULTRA HIGH-SPEED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

ULTRA-FAST SWITCHING TIME -- t_{off} = 20 ns MAX.
LOW CAPACITY -- C_{obo} = 3.0 pF MAX. and C_{ibo} = 3.5 pF MAX.
HIGH FREQUENCY -- f_T = 850 MHz MIN.
LOW SATURATION VOLTAGE -- $V_{CE}(sat)$ = 0.18 V MAX. @ I_C = 10 mA
HIGH BREAKDOWN VOLTAGE -- LV_{CEO} = 15 V MIN.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 s Time Limit)	+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.7 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.35 Watt

Maximum Voltages and Current for Each Transistor

		2N4207	2N4208	2N4209
V_{CBO}	Collector to Base Voltage	−6.0 Volts	−12 Volts	−15 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−6.0 Volts	−12 Volts	−15 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts	−4.5 Volts	−4.5 Volts
I_C	Collector Current	50 mA	50 mA	50 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	2N4207 MIN.	2N4207 TYP.	2N4207 MAX.	2N4208 MIN.	2N4208 TYP.	2N4208 MAX.	**2N4209** MIN.	**2N4209** TYP.	**2N4209** MAX.	UNITS	TEST CONDITIONS
	Charge Storage Time [Note 6]		12	15		16	20		16	20	ns	I_C = 10 mA I_{B1} = I_{B2} = 10 mA
	Turn On Time [Note 6]		11	15		11	15		**11**	**15**	**ns**	**I_C = 10 mA I_{B1} = 1.0 mA**
$_{off}$	**Turn Off Time** [Note 6]		11	15		14	20		**14**	**20**	**ns**	**I_C = 10 mA I_{B1} = I_{B2} = 1.0 mA**
$_{obo}$	**Common Base, Open Circuit Output Capacitance**		2.0	3.0		2.0	3.0		**2.0**	**3.0**	**pF**	I_E = 0 **V_{CB} = −5.0 V**
$_{ibo}$	**Common Base, Open Circuit Input Capacitance**		2.4	3.5		2.4	3.5		**2.4**	**3.5**	**pF**	I_C = 0 **V_{EB} = −0.5 V**
	High Frequency Current Gain (f = 100 MHz)	6.5	11									I_C = 10 mA V_{CE} = −5.0 V
	High Frequency Current Gain (f = 100 MHz)				7.0	13		**8.5**	**13**			**I_C = 10 mA V_{CE} = −10 V**
$_{FE}$	DC Current Gain	35	85		15	60		35	60			I_C = 1.0 mA V_{CE} = −0.5 V
$_{FE}$	**DC Pulse Current Gain** [Note 5]	50	100	120	30	67	120	**50**	**67**	**120**		**I_C = 10 mA** V_{CE} = −0.3 V
$_{FE}$	DC Pulse Current Gain [Note 5]	40	75		30	60		40	60			I_C = 50 mA V_{CE} = −1.0 V
$_{FE}$ (−55°C)	**DC Pulse Current Gain** [Note 5]	20	50		12	40		**20**	**40**			**I_C = 10 mA** V_{CE} = −0.3 V

* Planar is a patented Fairchild process.

TES:

These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 500°C/watt (derating factor of 2.3 mW/°C). Junction to case thermal resistance of 250°C/watt (derating factor of 4.57 mW/°C).
Rating refers to a high current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.
See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

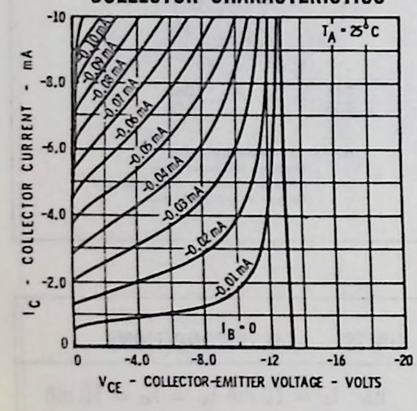
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N4207			2N4208			2N4209					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{CE} (sat)	Collector Saturation Voltage		−.07	−0.13		−.07	−0.13		−.07	−0.15	Volts	I_C = 1.0 mA	I_B = 0.1
V_{CE} (sat)	**Pulsed Collector Saturation Voltage [Note 5]**		**−.08**	**−0.15**		**−.08**	**−0.15**		**−.08**	**−0.18**	**Volts**	**I_C = 10 mA**	I_B = 1.
V_{CE} (sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.2	−0.5		−0.25	−0.5		−0.25	−0.6	Volts	I_C = 50 mA	I_B = 5.
V_{BE} (sat)	Base Saturation Voltage		−0.73	−0.8		−0.73	−0.8		−0.73	−0.8	Volts	I_C = 1.0 mA	I_B = 0.1
V_{BE} (sat)	Pulsed Base Saturation Voltage	−0.8	−0.88	−0.95	−0.8	−0.88	−0.95	−0.8	−0.88	−0.95	Volts	I_C = 10 mA	I_B = 1.
V_{BE} (sat)	Pulsed Base Saturation Voltage		−1.15	−1.5		−1.15	−1.5		−1.15	−1.5	Volts	I_C = 50 mA	I_B = 5.
I_{CES}	Collector Reverse Current		0.020	10							nA	V_{CE} = −3.0 V	V_{BE} = 0
I_{CES}	Collector Reverse Current					0.048	10				nA	V_{CE} = −6.0 V	V_{BE} = 0
I_{CES}	Collector Reverse Current								0.068	10	nA	V_{CE} = −8.0 V	V_{BE} = 0
I_{CES} (125°C)	Collector Reverse Current		0.012	5.0							μA	V_{CE} = −3.0 V	V_{BE} = 0
I_{CES} (125°C)	Collector Reverse Current					0.012	5.0				μA	V_{CE} = −6.0 V	V_{BE} = 0
I_{CES} (125°C)	Collector Reverse Current								0.012	5.0	μA	V_{CE} = −8.0 V	V_{BE} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5			−4.5			−4.5			Volts	I_C = 0	I_E = 10
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage [Note 4]**	**−6.0**			**−12**			**−15**			**Volts**	**I_C = 3.0 mA**	I_B = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−6.0			−12			−15			Volts	I_C = 100 μA	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−6.0			−12			−15			Volts	I_C = 100 μA	I_B = 0

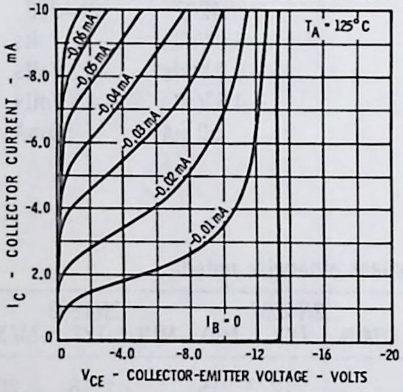
TYPICAL ELECTRICAL CHARACTERISTICS

2N4207

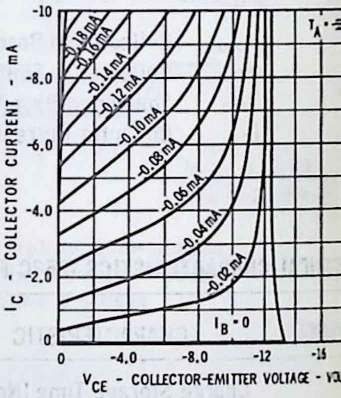
COLLECTOR CHARACTERISTICS*



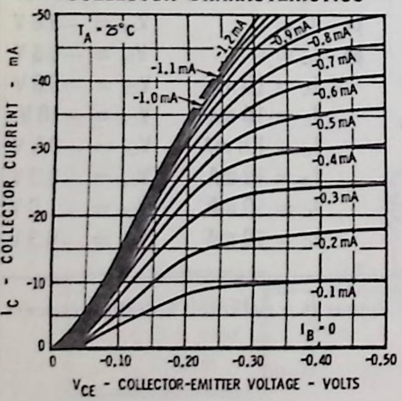
COLLECTOR CHARACTERISTICS*



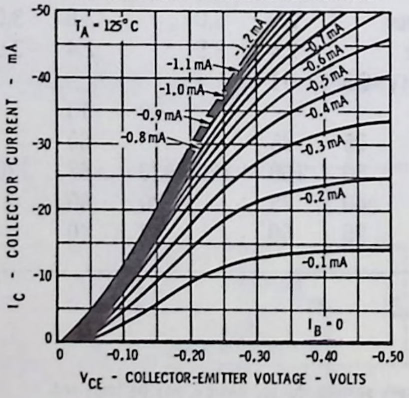
COLLECTOR CHARACTERISTI



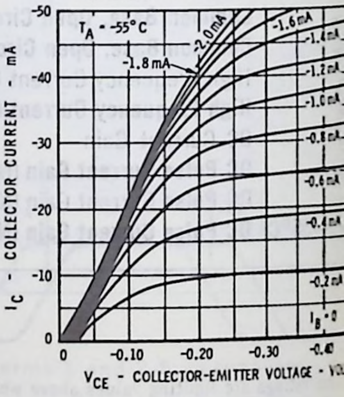
COLLECTOR CHARACTERISTICS*



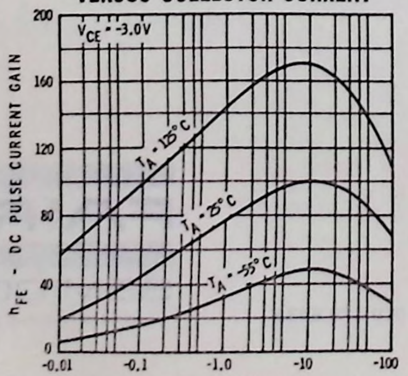
COLLECTOR CHARACTERISTICS*



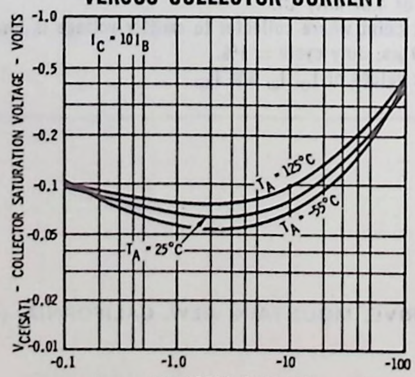
COLLECTOR CHARACTERISTI



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



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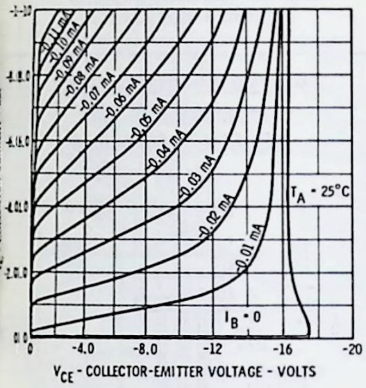
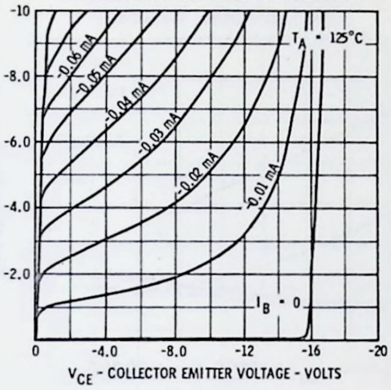
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS
2N4208 • 2N4209

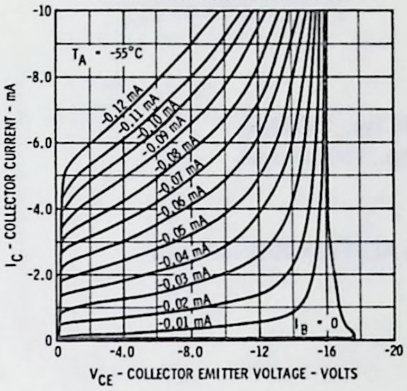
COLLECTOR CHARACTERISTICS



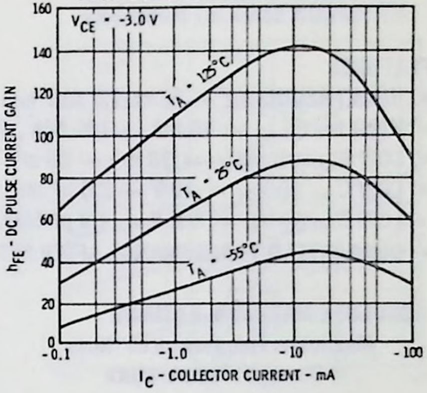
COLLECTOR CHARACTERISTICS



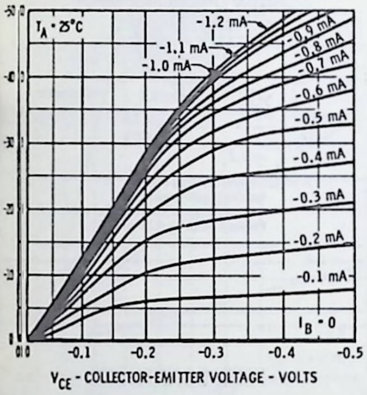
COLLECTOR CHARACTERISTICS



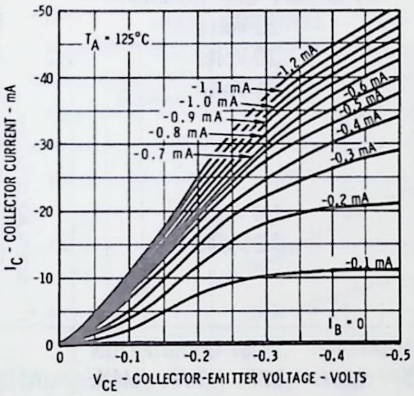
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



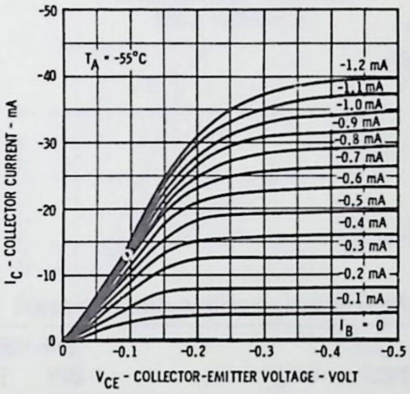
COLLECTOR CHARACTERISTICS



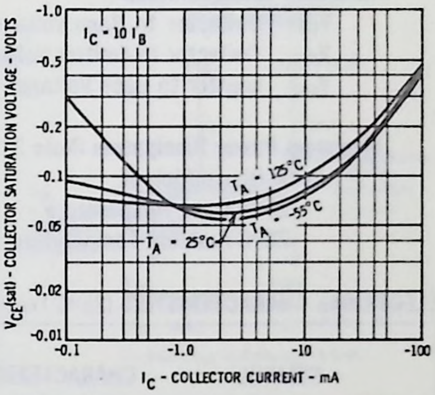
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS

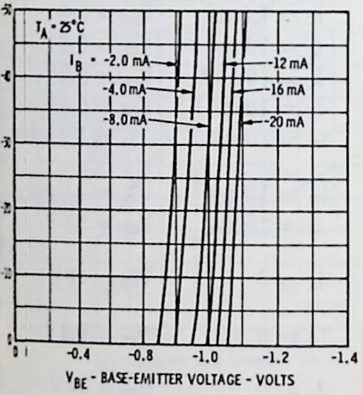


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

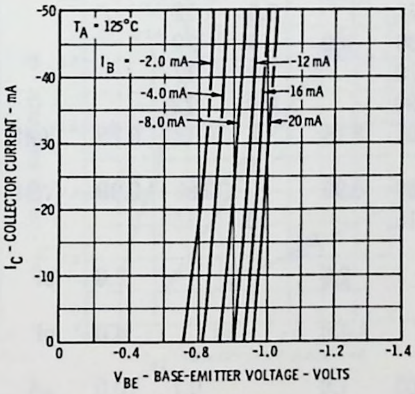


TYPICAL ELECTRICAL CHARACTERISTICS
2N4207 • 2N4208 • 2N4209

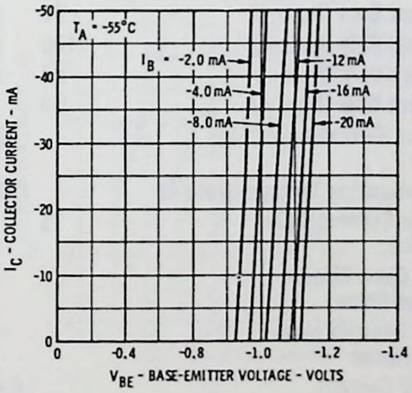
BASE CHARACTERISTICS



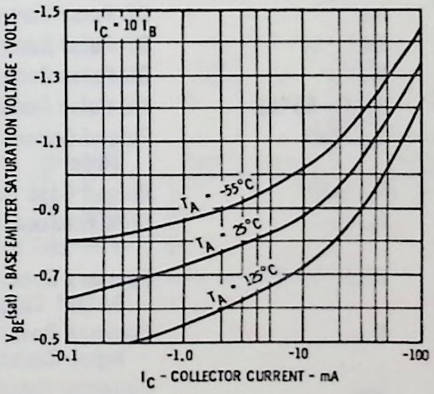
BASE CHARACTERISTICS



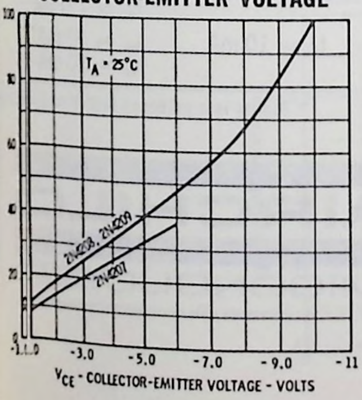
BASE CHARACTERISTICS



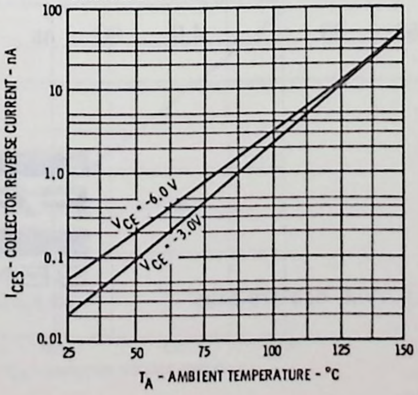
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



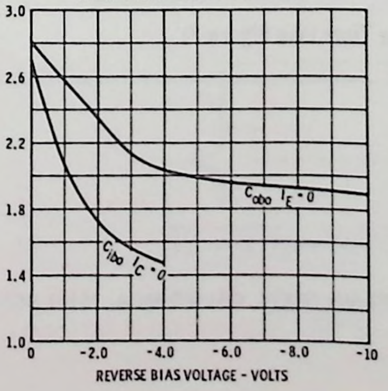
COLLECTOR REVERSE CURRENT VERSUS COLLECTOR-EMITTER VOLTAGE



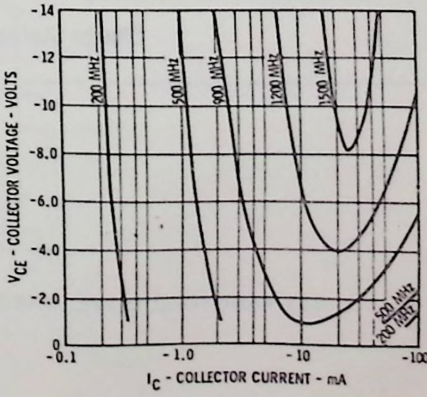
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



2N4251

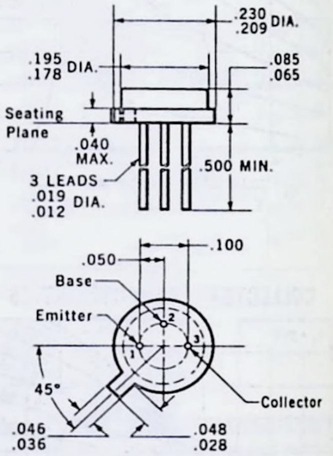
NPN RADIATION RESISTANT SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FEATURES

- **HIGH FREQUENCY — f_T = 1.3 GHz Min.**
- **HIGH h_{FE} @ I_C = 10 mA — 100 Min., 180 Typ., 300 Max.**
- **LOW V_{CE}(sat) @ I_C = 10 mA — 50 mV Typ., 150 mV Max.**
- **LOW C_{obo} @ V_{CB} = 10 V — 2.0 pF Max.**
- **LOW C_{ibo} @ V_{EB} = 0.5 V — 4.0 pF Max.**
- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSE (10^{15} nvt)**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.36 gram

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures (Note 1)	
Storage Temperature	−55°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 10 seconds Time Limit)	+300°C Maximum
Maximum Voltages (Note 1)	
V_{CBO} Collector to Base Voltage	15 Volts
V_{CEO} Collector to Emitter Voltage	10 Volts
V_{EBO} Emitter to Base Voltage	4.5 Volts
Maximum Power Dissipation (Note 2 and 3)	
Total Dissipation at	
25°C Case Temperature	1.3 Watts
25°C Ambient Temperature	0.25 Watt

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		PRE-IRRADIATION			POST-IRRADIATION					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 4 and 6)	10	12		10	20		Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	15	23		15	25		Volts	I_C = 1.0 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5	5.5		4.5	5.6		Volts	I_C = 0	I_E = 1.0 mA
h_{FE}	**DC Pulse Current Gain** (Note 4)	**32**	78		**5.0**	7.0			**I_C = 100 μA**	V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 4)	**62**	124		**9.0**	12			**I_C = 1.0 mA**	V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 4)	**100**	180	300	**15**	20			**I_C = 10 mA**	V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 4)	**94**	170		**14**	17			**I_C = 100 mA**	V_{CE} = 5.0 V
h_{FE} (−55°C)	**DC Pulse Current Gain** (Note 4)	**50**	90		**8.0**	12			**I_C = 10 mA**	V_{CE} = 5.0 V
V_{CE} (sat)	Pulsed Collector Saturation Voltage (Note 4)		0.05	0.15		0.18	0.25	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Pulsed Base Saturation Voltage (Note 4)		0.80	0.90		0.80	0.90	Volts	I_C = 10 mA	I_B = 1.0 mA
h_{fe}	**High Frequency Current Gain** (f = 100 MHz)	**13**	15		**10**	13			**I_C = 10 mA**	V_{CE} = 5.0 V
C_{obo}	**Common Base, Open Circuit Output Capacitance**			**2.0**			**2.0**	pF	I_E = 0	**V_{CB} = 10 V**
C_{ibo}	**Common Base, Open Circuit Input Capacitance**			**4.0**			**4.0**	pF	I_C = 0	**V_{EB} = 0.5 V**
I_{CBO}	Collector Cutoff Current		0.005	1.0		0.1	10.0	μA	I_E = 0	V_{CB} = 10 V
I_{CBO} (150°C)	Collector Cutoff Current			10			10	μA	I_E = 0	V_{CB} = 10 V
t_{on}	Turn On Time (see Figure 1)		13	20		13	20	ns	I_C = 10 mA	I_{B1} = 1.0 mA
t_{off}	Turn Off Time (see Figure 1)		49	60		5.0	60	ns	I_C = 10 mA	I_{B1} = 1.0 mA I_{B2} = 1.0 mA
τ_s	Charge Storage Time (see Figure 2)		60	80		4.0	80	ns	I_C = 10 mA	I_{B1} = 10 mA I_{B2} = 10 mA

* Planar is a patented Fairchild proce

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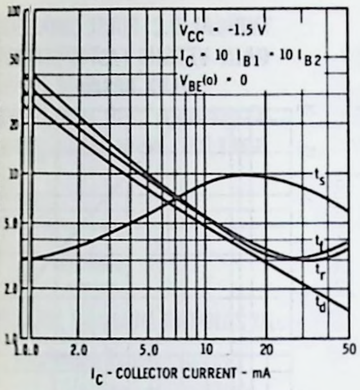
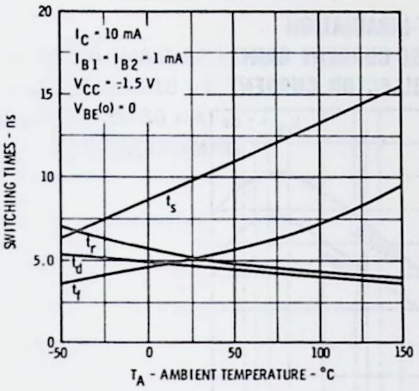
TYPICAL ELECTRICAL CHARACTERISTICS
2N4207 • 2N4208 • 2N4209

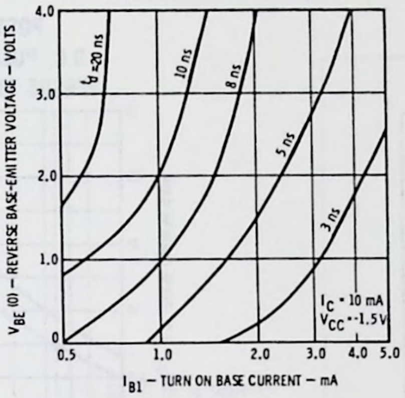
SWITCHING TIMES VERSUS COLLECTOR CURRENT



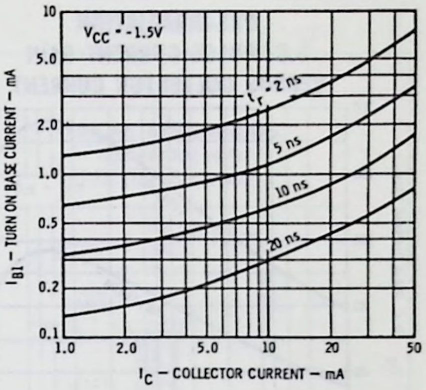
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



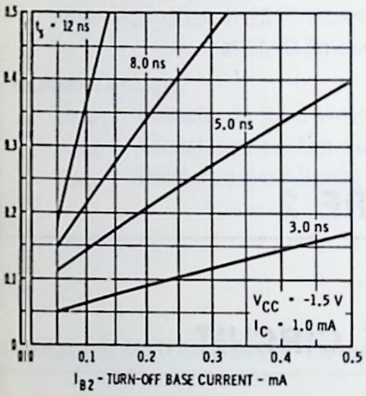
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



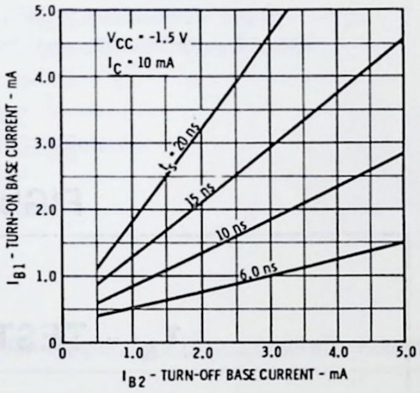
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



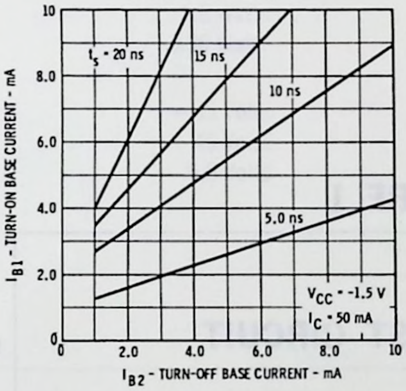
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



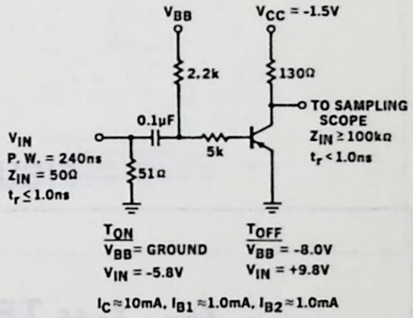
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



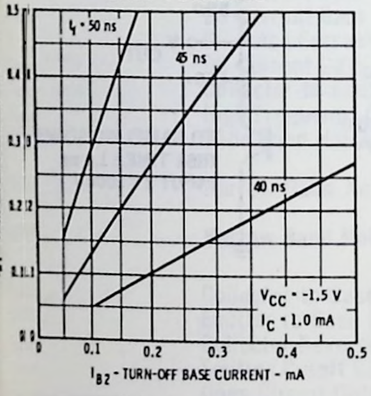
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



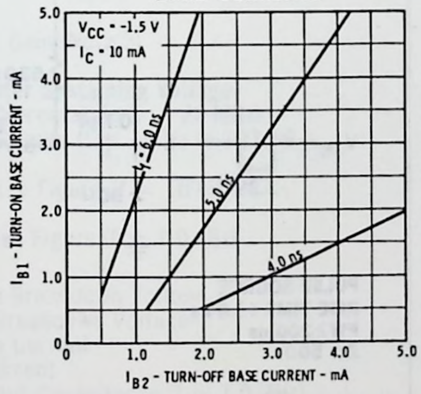
TURN ON AND TURN OFF TEST CIRCUIT


V_BB
V_CC = -1.5V
2.2k
130Ω
TO SAMPLING SCOPE
Z_IN ≥ 100kΩ
t_r < 1.0ns
0.1µF
5k
V_IN
P. W. = 240ns
Z_IN = 50Ω
t_r ≤ 1.0ns
51Ω
T_ON
V_BB = GROUND
V_IN = -5.8V
T_OFF
V_BB = -8.0V
V_IN = +9.8V
I_C ≈ 10mA, I_B1 ≈ 1.0mA, I_B2 ≈ 1.0mA

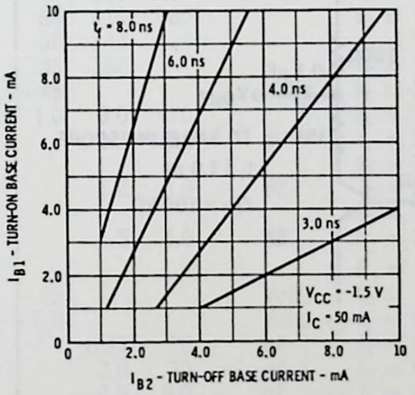
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



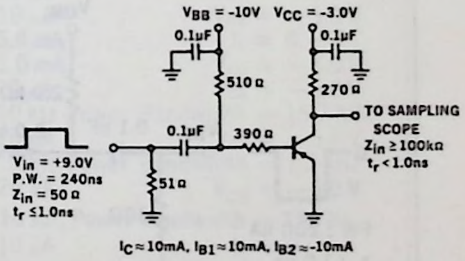
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



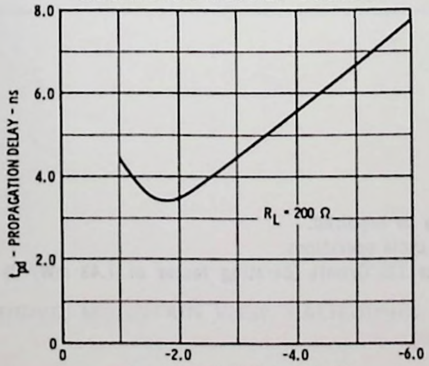
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



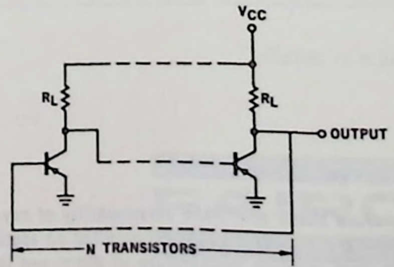
CHARGE STORAGE TIME TEST CIRCUIT


V_BB = -10V
V_CC = -3.0V
0.1µF
0.1µF
510Ω
270Ω
TO SAMPLING SCOPE
Z_in ≥ 100kΩ
t_r < 1.0ns
0.1µF
390Ω
V_in = +9.0V
P.W. = 240ns
Z_in = 50Ω
t_r ≤ 1.0ns
51Ω
I_C ≈ 10mA, I_B1 ≈ 10mA, I_B2 ≈ -10mA

PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE

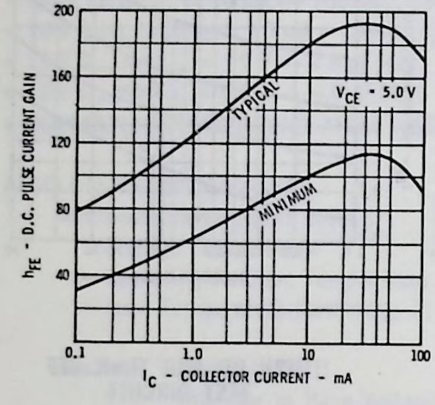


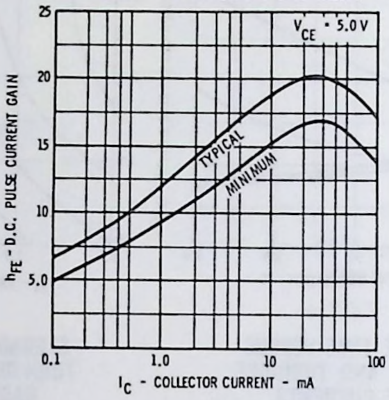
FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY


V_CC
R_L
R_L
OUTPUT
N TRANSISTORS

$$t_{pd} = \frac{1}{2Nf_{osc}}$$

TYPICAL ELECTRICAL CHARACTERISTICS


PRE-IRRADIATION D.C. PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT


POST-IRRADIATION D.C. PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

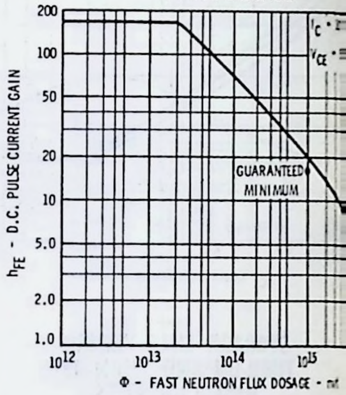

TYPICAL D.C. PULSE CURRE
GAIN VERSUS FAST-NEUTR
FLUX DOSAGE

FIGURE 1

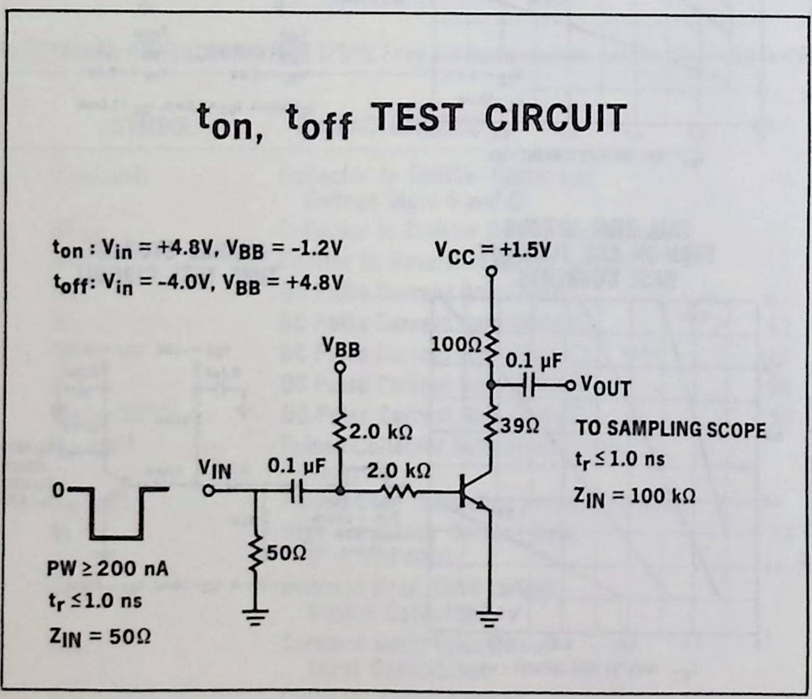
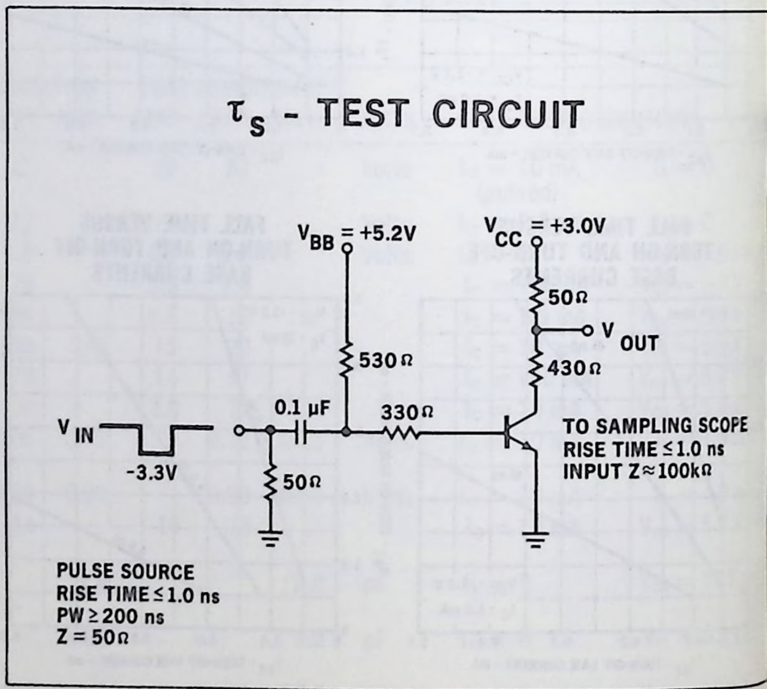

t_{on}, t_{off} TEST CIRCUIT
t_{on} : V_{in} = +4.8V, V_{BB} = -1.2V
t_{off}: V_{in} = -4.0V, V_{BB} = +4.8V
V_{CC} = +1.5V
100Ω
0.1 μF
V_{OUT}
39Ω
TO SAMPLING SCOPE
t_r ≤ 1.0 ns
Z_{IN} = 100 kΩ
V_{BB}
2.0 kΩ
V_{IN}
0.1 μF
2.0 kΩ
0
50Ω
PW ≥ 200 nA
t_r ≤ 1.0 ns
Z_{IN} = 50Ω

FIGURE 2


τ_s - TEST CIRCUIT
V_{BB} = +5.2V
530Ω
V_{CC} = +3.0V
50Ω
V_{OUT}
430Ω
V_{IN}
-3.3V
0.1 μF
330Ω
50Ω
TO SAMPLING SCOPE
RISE TIME ≤ 1.0 ns
INPUT Z ≈ 100kΩ
PULSE SOURCE
RISE TIME ≤ 1.0 ns
PW ≥ 200 ns
Z = 50Ω

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings based on maximum junction temperature of 200°C and junction to case thermal resistance of 135°C/watt (derating factor of 7.43 mW/°C) and junction to ambient thermal resistance of 700°C/watt (derating factor of 1.43 mW/°C).

(4) Pulse conditions: length = 300 μs; duty cycle = 1%.

(5) Post-irradiation characteristics after an integrated fast (>100 KEV) neutron flux of 10^{15} nvt (neutrons per cm²).

(6) This rating refers to a high-current point where collector to emitter voltage is lowest.

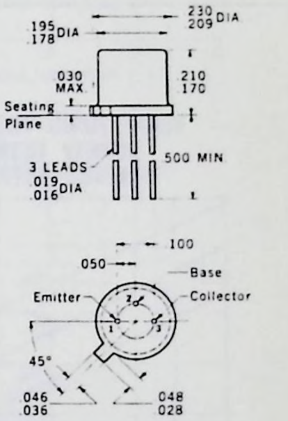
2N4359

PNP LOW-NOISE, LOW-LEVEL AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

LOW NOISE . . . . NF = 4.0 dB (MAX) AT 1.0 kHz
HIGH BETA . . . . h_{FE} = 50-500 AT 10 μA
EXCELLENT BETA LINEARITY . . . FROM 10 μA TO 50 mA
HIGH BREAKDOWN VOLTAGE . . . LV_{CEO} = 45 VOLTS (MIN)

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C
Lead Temperature (Soldering, 60 Sec. Time Limit)	300°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.2 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.36 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	−45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−45 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts

CTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$_{FE}$	**DC Current Gain**	**50**	**210**	**500**		**I_C = 10 μA**	**V_{CE} = −5.0 V**
$_{FE}$	DC Current Gain	50	260			I_C = 100 μA	V_{CE} = −5.0 V
$_{FE}$	**DC Current Gain**	**50**	**310**	**600**		**I_C = 1.0 mA**	**V_{CE} = −5.0 V**
$_{FE}$	DC Pulse Current Gain (Note 5)	50	340			I_C = 10 mA	V_{CE} = −5.0 V
$_{FE}$ (0°C)	DC Current Gain	35	160			I_C = 10 μA	V_{CE} = −5.0 V
$_{CEO}$ (sust)	**Collector to Emitter Sustaining Voltage**	**−45**			**Volts**	**I_C = 5.0 mA**	**I_B = 0**
$_{fe}$	High Frequency Current Gain (f = 20 MHz)	1.0	6.0	10		I_C = 1.0 mA	V_{CE} = −5.0 V
F	Wide Band Noise Figure (f = 10 Hz to 10 kHz)		1.7	5.0	dB	I_C = 20 μA R_S = 10 kΩ Power Bandwidth = 15.7 kHz	V_{CE} = −5.0 V
F	Narrow Band Noise Figure (f = 10 kHz)		1.0	3.0	dB	I_C = 20 μA R_S = 10 kΩ Power Bandwidth = 1.5 kHz	V_{CE} = −5.0 V
F	**Narrow Band Noise Figure (f = 1.0 kHz)**		**1.5**	**4.0**	**dB**	**I_C = 20 μA** **R_S = 10 kΩ, Power Bandwidth = 150 Hz**	**V_{CE} = −5.0 V**
V_{CBO}	Collector to Base Breakdown Voltage	−45			Volts	I_C = 10 μA	I_E = 0
V_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	I_C = 0	I_E = 100 μA
$_{CBO}$	Collector Reverse Current		0.35	10	nA	I_E = 0	V_{CB} = −25 V
$_{EBO}$	Emitter Cutoff Current		2.0	20	nA	I_C = 0	V_{EB} = −3.0 V
$_{obo}$	Open Circuit Output Capacitance (f = 1.0 MHz)		4.0	6.0	pF	I_E = 0	V_{CB} = −5.0 V
$_{ibo}$	Open Circuit Input Capacitance (f = 1.0 MHz)		14	18	pF	I_C = 0	V_{EB} = −0.5 V
$_{CBO}$ (85°C)	Collector Reverse Current		0.05	2.0	μA	I_E = 0	V_{CB} = −25 V
$_{CE}$ (sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.13	−0.25	Volts	I_C = 10 mA	I_B = 1.0 mA
$_{BE}$ (sat)	Pulsed Base Saturation Voltage (Note 5)		−0.76	−0.90	Volts	I_C = 10 mA	I_B = 1.0 mA

* Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

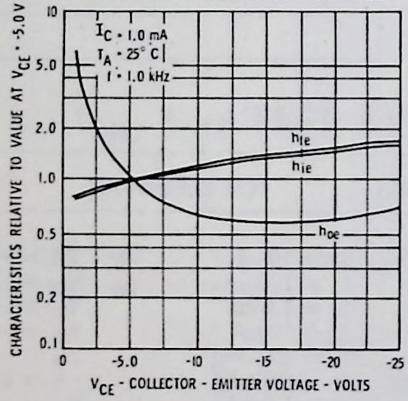
FAIRCHILD TRANSISTOR 2N4359

SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

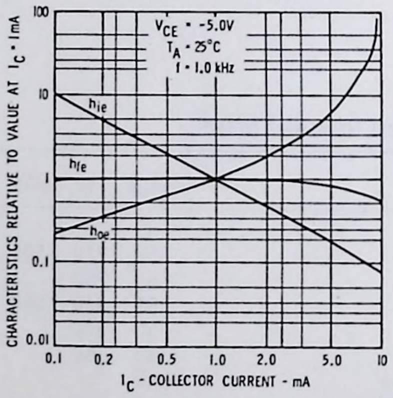
SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain	50	700		$I_C = 1.0$ mA	$V_{CE} = -5.0$
h_{ie}	Input Resistance	1.0	20	k ohms	$I_C = 1.0$ mA	$V_{CE} = -5.0$
h_{oe}	Output Conductance	5.0	60	µmhos	$I_C = 1.0$ mA	$V_{CE} = -5.0$
h_{re}	Voltage Feedback Ratio		10	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -5.0$

TYPICAL ELECTRICAL CHARACTERISTICS

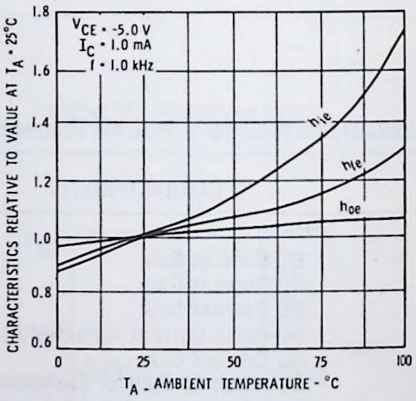
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



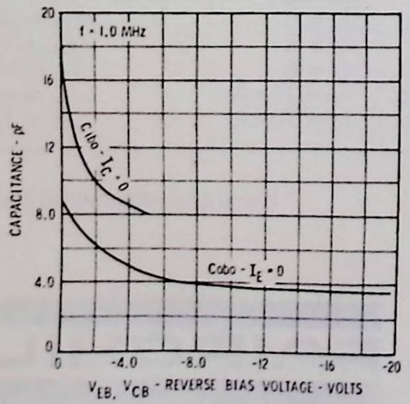
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



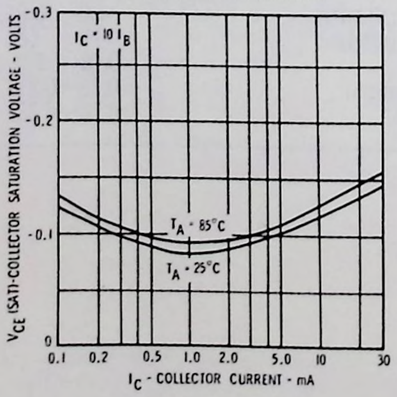
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



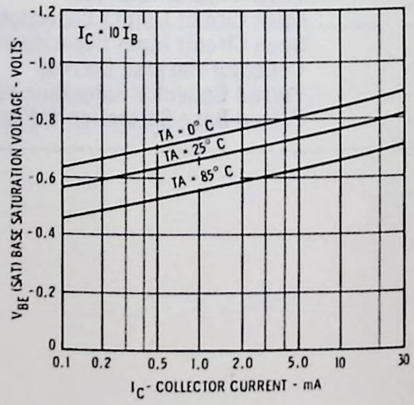
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

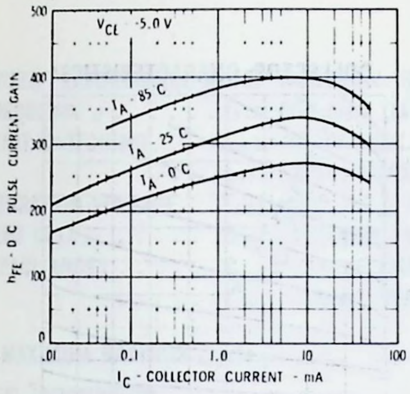


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

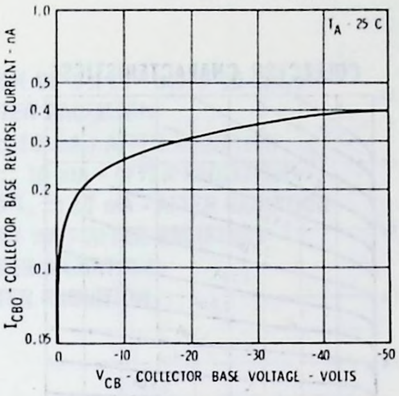


TYPICAL ELECTRICAL CHARACTERISTICS

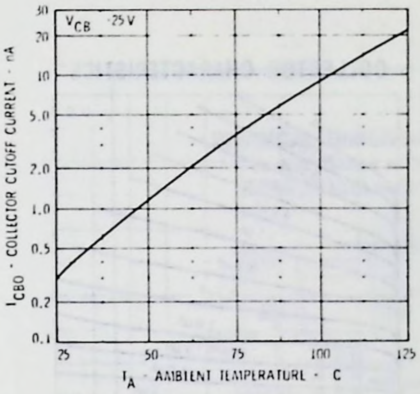
DC PULSE-CURRENT GAIN VERSUS COLLECTOR CURRENT



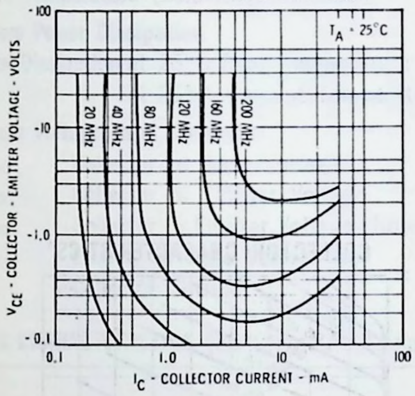
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



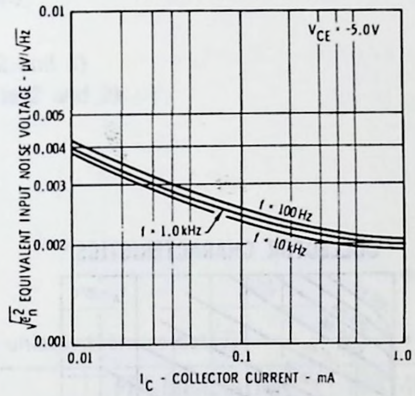
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



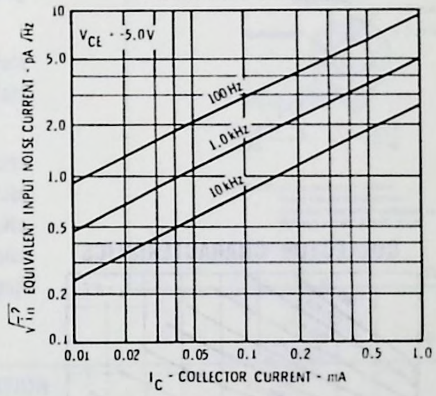
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



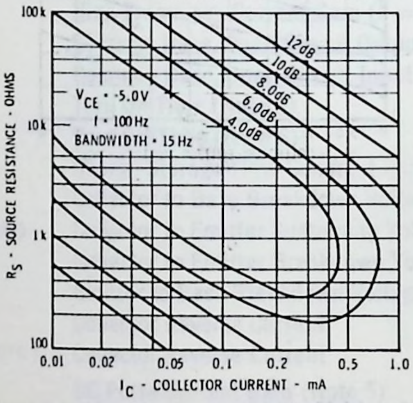
EQUIVALENT INPUT NOISE VOLTAGE VERSUS COLLECTOR CURRENT



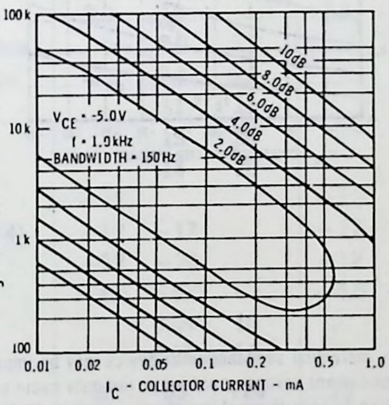
EQUIVALENT INPUT NOISE CURRENT VERSUS COLLECTOR CURRENT



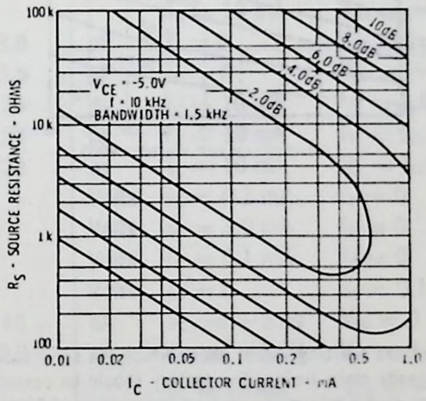
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



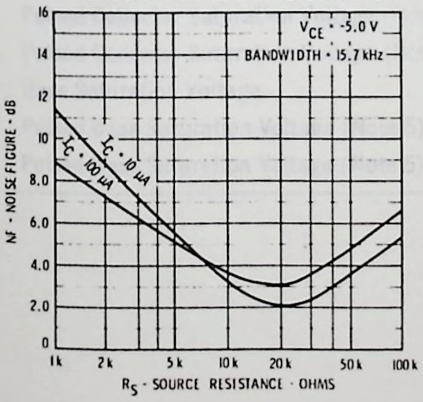
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



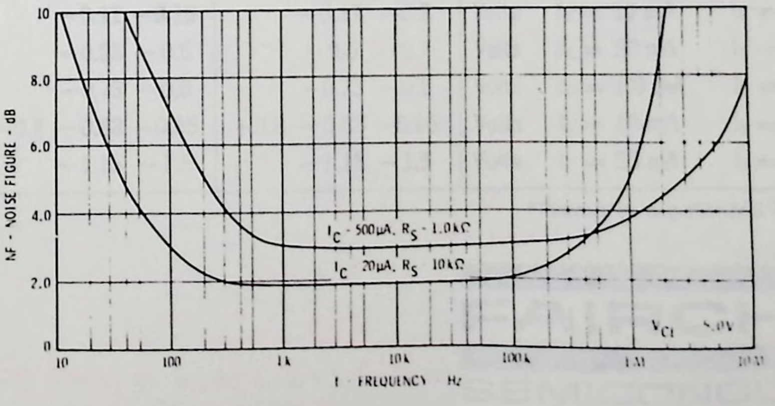
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



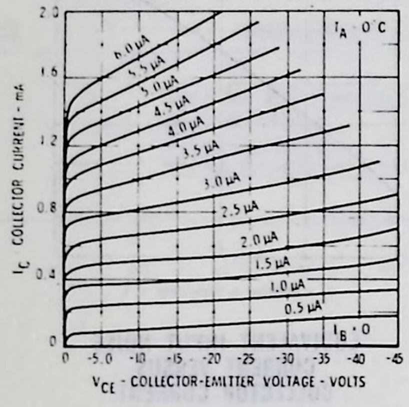
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE

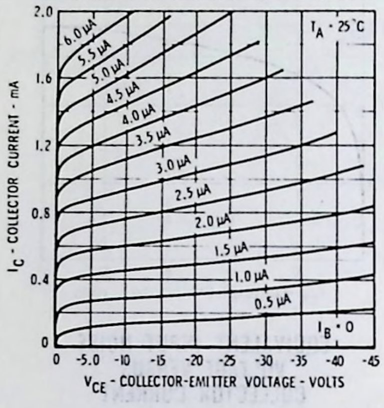


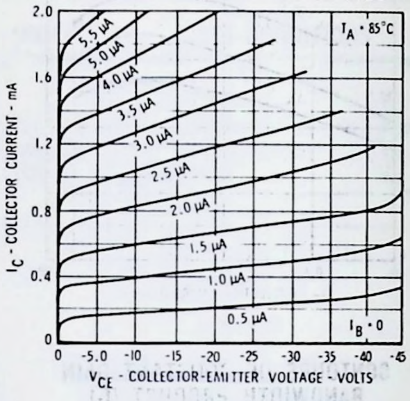
NOISE FIGURE VERSUS FREQUENCY

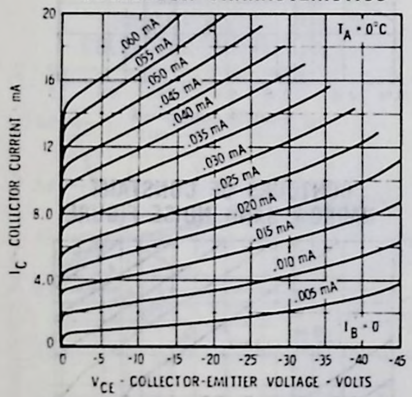


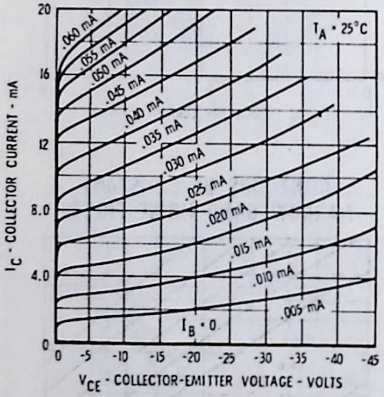
TYPICAL ELECTRICAL CHARACTERISTICS

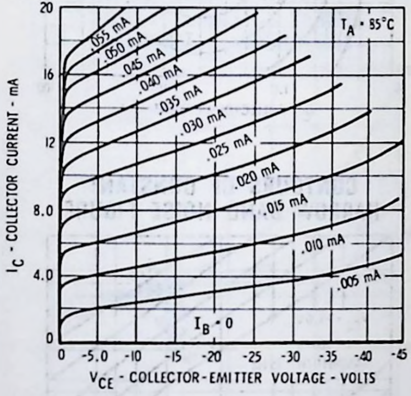

COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low-duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction to ambient thermal of 486°C/Watt (derating factor of 2.06 mW/°C).

(4) This rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 µs; duty cycle = 1%.

* Single family characteristic on Transistor Curve Tracer.

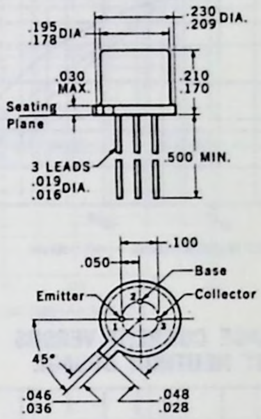
2N4872

PNP RADIATION RESISTANT SWITCH

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTOR

GUARANTEED PERFORMANCE AFTER NEUTRON IRRADIATION OF 3 X 10^{14} nvt (> 10 keV.)
HIGH FREQUENCY . . . . f_T = 800 MHz (MIN.) - AFTER RADIATION
ULTRA-FAST SWITCHING . . . . t_{on} = 20 ns (MAX.) @ I_C = 10 mA - AFTER RADIATION
. . . . t_{off} = 20 ns (MAX.) @ I_C = 10 mA - AFTER RADIATION
LOW SATURATION VOLTAGE . . V_{CE}(sat) = 0.2 V (MAX.) @ I_C = 10 mA - AFTER RADIATION
EXCELLENT BETA . . . . h_{FE} = 15 (MIN.) @ I_C = 10 mA - AFTER RADIATION
LOW CAPACITANCE . . . . C_{obo} = 3.0 pF (MAX.) - AFTER RADIATION
. . . . C_{ibo} = 3.5 pF (MAX.) - AFTER RADIATION

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 10 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Note 2 and 3)	0.7 Watt
at 25°C Ambient Temperature (Note 2 and 3)	0.3 Watt

Maximum Voltages and Currents

V_{CBO}	Collector to Base Voltage	−12 Volts
V_{CES}	Collector to Emitter Voltage	−12 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−12 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts
I_C	Collector Current	50 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		PRE-IRRADIATION			POST-IRRADIATION 3X10^{14} nvt(>10 keV)					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	9.0	10		8.0	9.0			I_C = 10 mA	V_{CE} = −10 V
C_{obo}	**Common Base, Open Circuit Output Capacitance**		2.0	3.0		2.0	3.0	pF	I_E = 0	V_{CB} = −5.0 V
C_{ibo}	**Common Base, Open Circuit Input Capacitance**		2.4	3.5		2.4	3.5	pF	I_C = 0	V_{EB} = −0.5 V
t_{on}	**Turn On Time** (Note 6)		11	15		15	20	ns	I_C ≈ 10 mA	I_{B1} ≈ 1.0 mA
t_{off}	**Turn Off Time** (Note 6)		15	20		9.0	20	ns	I_C ≈ 10 mA	I_{B1} = I_{B2} ≈ 1.0 mA
τ_S	Charge Storage Time Constant (Note 6)		14	20		6.0	20	ns	I_C ≈ 10 mA	I_{B1} = I_{B2} ≈ 10 mA
BV_{CBO}	Collector to Base Breakdown Voltage	−12			−12			Volts	I_C = 0.1 mA	I_B = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 4)	−12	−17		−12	−19		Volts	I_C = 3.0 mA	I_B = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−12	−20		−12	−20		Volts	I_C = 0.1 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5	−5.0		−4.5	−5.0		Volts	I_C = 0	I_E = 0.1 mA
I_{CES}	Collector Reverse Current		0.04	10		0.4	10	nA	V_{CE} = −6.0V	V_{BE} = 0
I_{CES}(125°C)	Collector Reverse Current		0.02	5.0		0.2	5.0	μA	V_{CE} = −6.0V	V_{BE} = 0
h_{FE}	**DC Pulse Current Gain** (Note 5)	50	65	120	15	20			I_C = 10 mA	V_{CE} = −0.3 V
h_{FE}(−55°C)	**DC Pulse Current Gain** (Note 5)	20	30		6.0	8.0			I_C = 10 mA	V_{CE} = −0.3 V
V_{CE}(sat)	Collector Saturation Voltage		−0.08	−0.13		−0.17	−0.2	Volts	I_C = 1.0 mA	I_B = 0.1 mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		**−0.11**	**−0.15**		**−0.17**	**−0.2**	**Volts**	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.28	−0.5		−0.5	−0.7	Volts	I_C = 50 mA	I_B = 5.0 mA
V_{BE}(sat)	Base Saturation Voltage		−0.73	−0.8		−0.73	−0.8	Volts	I_C = 1.0 mA	I_B = 0.1 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)	−0.8	−0.88	−0.95	−0.8	−0.88	−0.95	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−1.15	−1.5		−1.15	−1.5	Volts	I_C = 50 mA	I_B = 5.0 mA

*Planar is a patented Fairchild process.

FAIRCHILD
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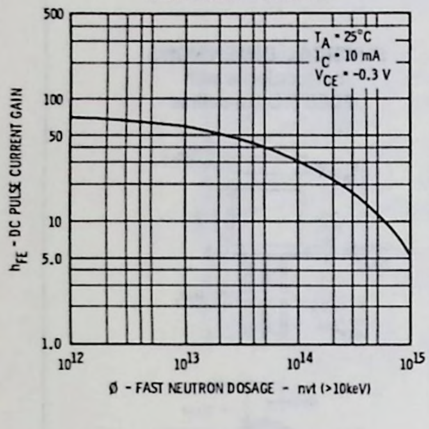
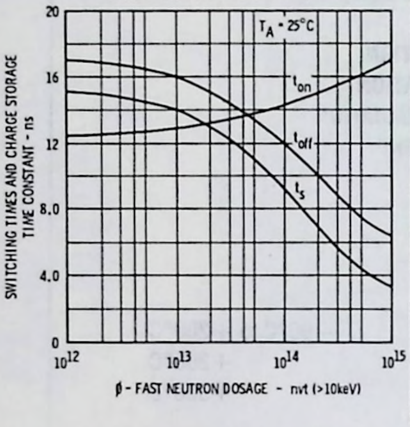
TYPICAL ELECTRICAL CHARACTERISTICS

POST-IRRADITION

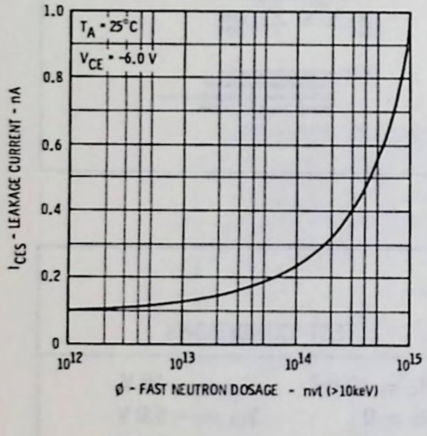
DC PULSE CURRENT GAIN VERSUS FAST NEUTRON DOSAGE



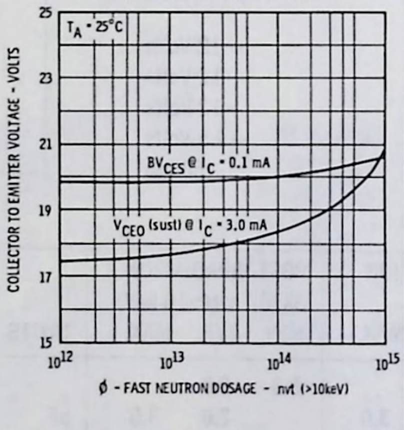
SWITCHING TIMES AND CHARGE STORAGE TIME CONSTANT VERSUS FAST NEUTRON DOSAGE



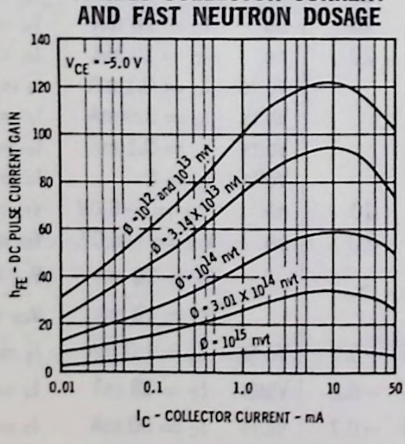
LEAKAGE CURRENT VERSUS FAST NEUTRON DOSAGE



COLLECTOR TO EMITTER VOLTAGES VERSUS FAST NEUTRON DOSAGE

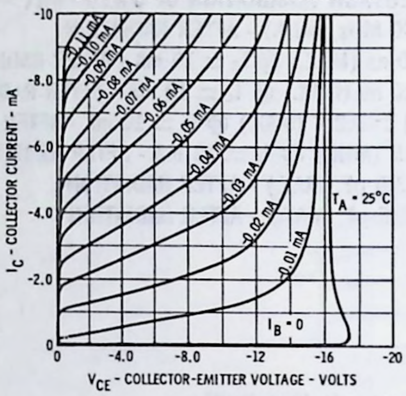


DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT AND FAST NEUTRON DOSAGE

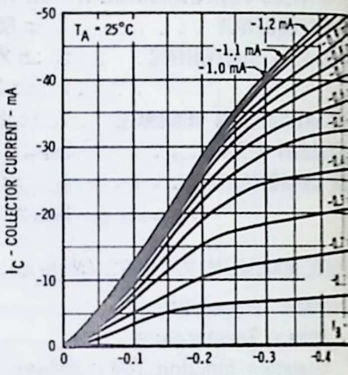


PRE-IRRADIATION

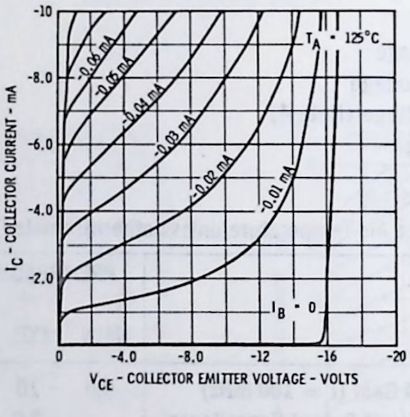
COLLECTOR CHARACTERISTICS°



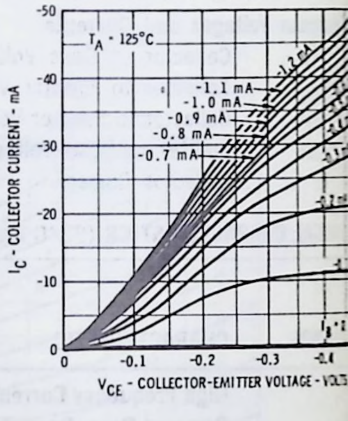
COLLECTOR CHARACTERISTIC



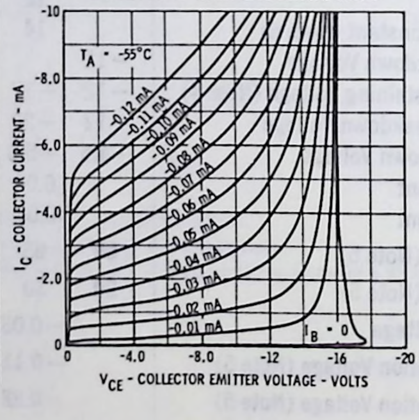
COLLECTOR CHARACTERISTICS°



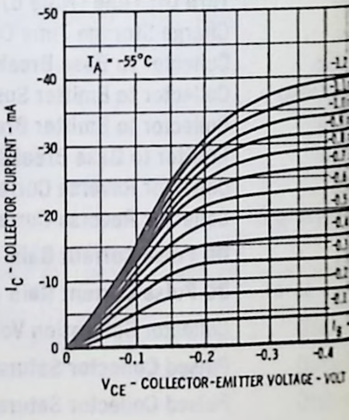
COLLECTOR CHARACTERISTIC



COLLECTOR CHARACTERISTICS°



COLLECTOR CHARACTERISTIC



° Single family characteristic on Transistor Curve Tracer.

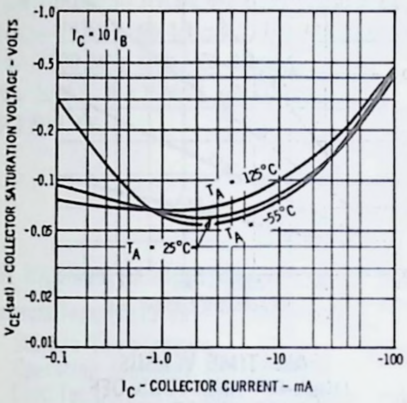
NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings are based on a maximum junction temperature of 200°C and junction to ambient thermal resistance of 586°C/Watt (derating factor of 1.72mW/°C); Junct to case thermal resistance of 250°C/Watt (derating factor of 4.0 mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

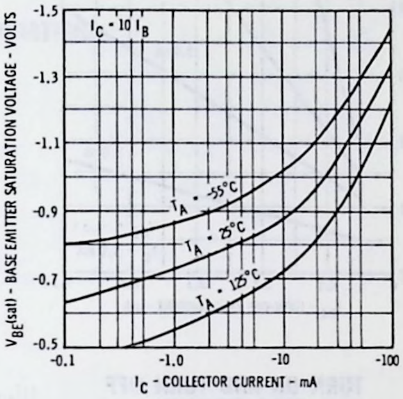
TYPICAL ELECTRICAL CHARACTERISTICS

PRE-IRRADIATION

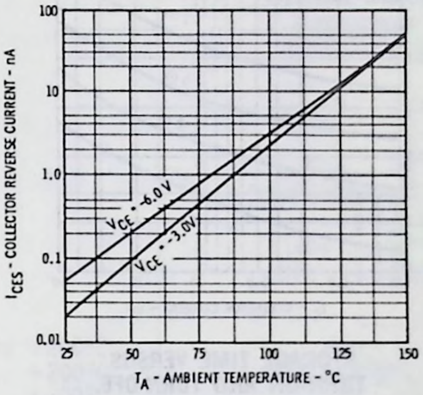
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



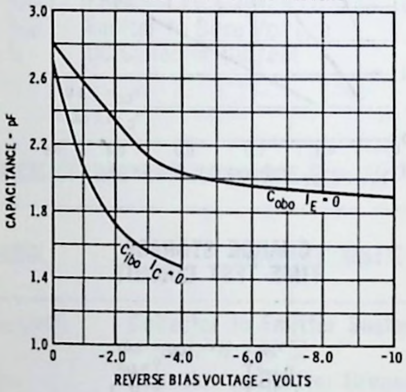
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



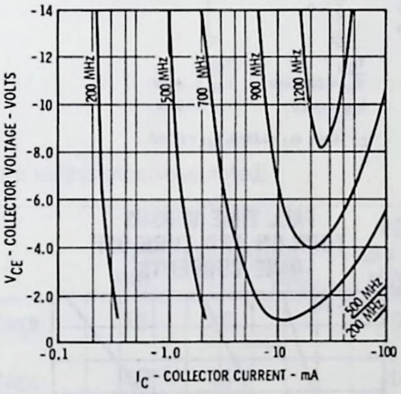
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



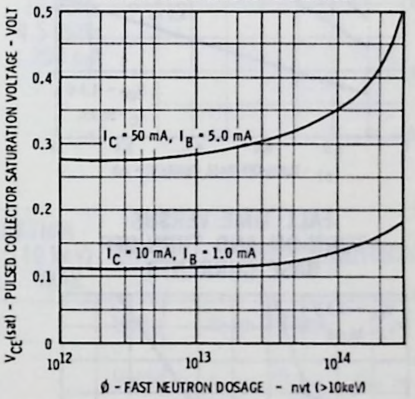
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



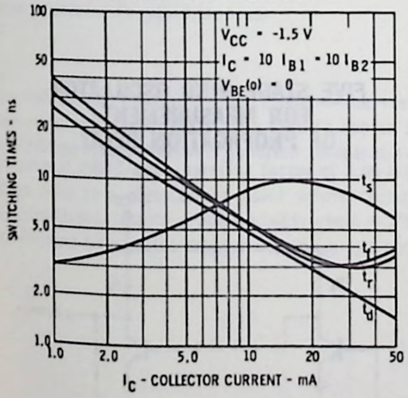
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



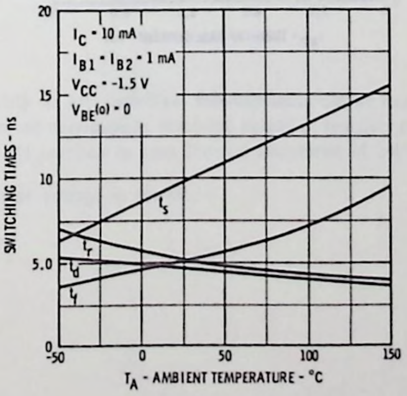
PULSED COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE



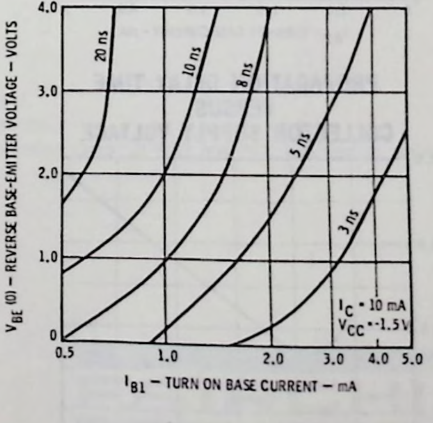
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



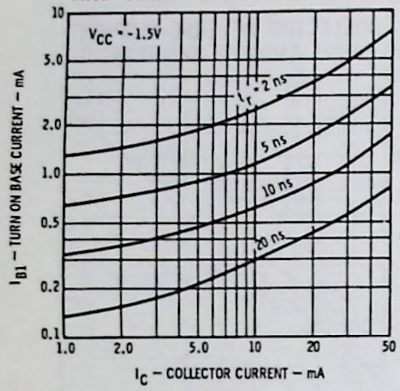
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



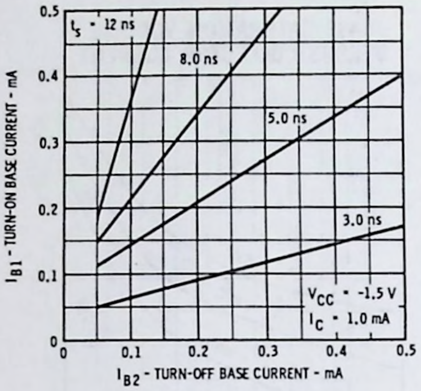
TYPICAL ELECTRICAL CHARACTERISTICS

PRE-IRRADIATION

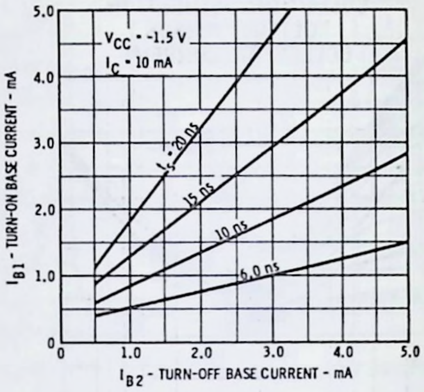
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



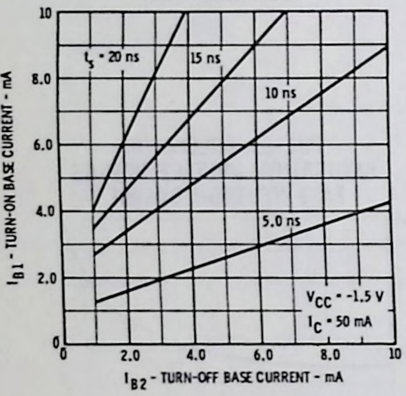
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



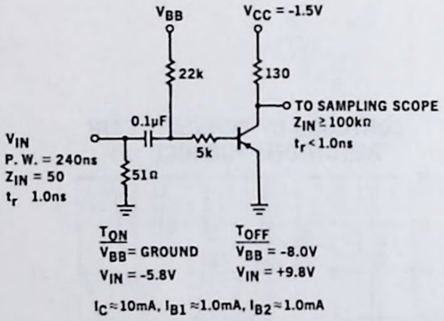
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



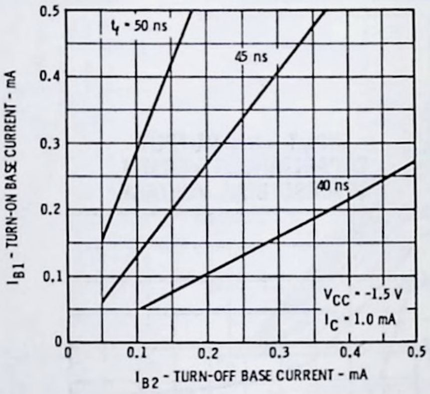
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



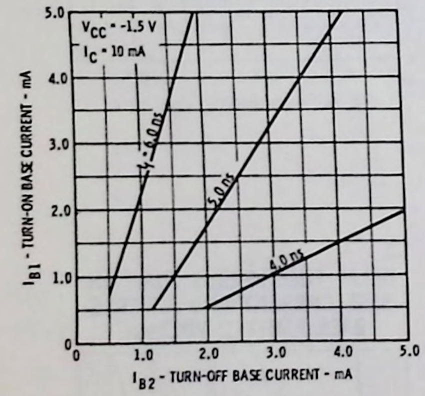
TURN ON AND TURN OFF TEST CIRCUIT


V_{BB}
V_{CC} = -1.5V
22k
130
TO SAMPLING SCOPE
$Z_{IN} \geq 100k\Omega$
$t_r < 1.0ns$
0.1µF
5k
V_{IN}
P. W. = 240ns
Z_{IN} = 50
t_r 1.0ns
51Ω
T_{ON}
V_{BB}= GROUND
V_{IN} = -5.8V
T_{OFF}
V_{BB} = -8.0V
V_{IN} = +9.8V
$I_C \approx 10mA$, $I_{B1} \approx 1.0mA$, $I_{B2} \approx 1.0mA$

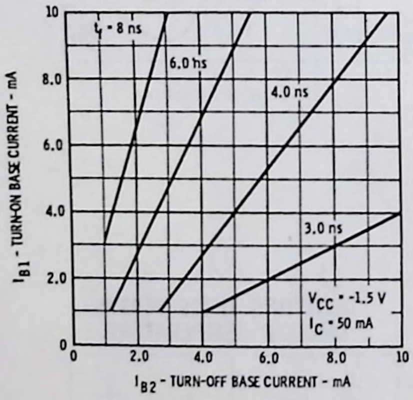
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



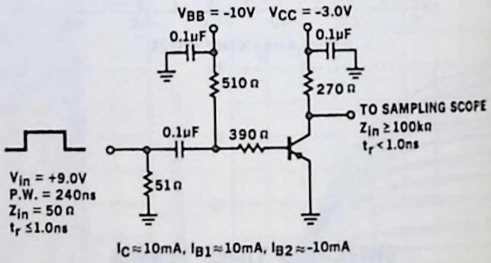
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



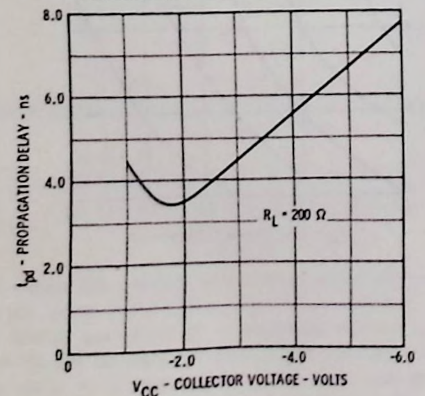
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



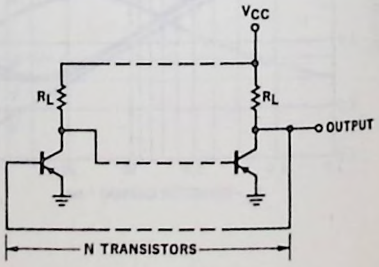
CHARGE STORAGE TIME TEST CIRCUIT


V_{BB} = -10V
V_{CC} = -3.0V
0.1µF
0.1µF
510 Ω
270 Ω
TO SAMPLING SCOPE
$Z_{in} \geq 100k\Omega$
$t_r < 1.0ns$
0.1µF
390 Ω
51 Ω
V_{in} = +9.0V
P.W. = 240ns
Z_{in} = 50 Ω
$t_r \leq 1.0ns$
$I_C \approx 10mA$, $I_{B1} \approx 10mA$, $I_{B2} \approx -10mA$

PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY


V_{CC}
R_L
R_L
OUTPUT
N TRANSISTORS

$$t_{pd} = \frac{1}{2Nf_{osc}}$$

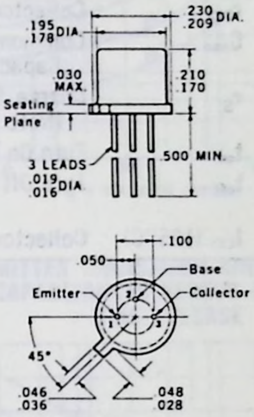
2N4873

RADIATION RESISTANT HIGH-SPEED NPN SATURATED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE (3 x 10^{14} nvt >10 keV)**
- **FAST SWITCHING — 13 ns MAX. τ_S @ 10 mA**
- **HIGH h_{FE} — 19 MIN. @ 10 mA, 1.0 V (110 MIN. PREIRRADIATION)**
- **HIGH f_T — 600 MHz MIN. @ 10 mA**
- **LOW V_{CE} (sat) — 0.3 V MAX. @ 10 mA**
- **15 VOLT MIN. LV_{CEO}**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Note 2 and 3]	1.2 Watts
at 100°C Case Temperature [Note 2 and 3]	0.68 Watt
at 25°C Ambient Temperature [Note 2 and 3]	0.36 Watt

Maximum Voltages and Currents

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	15 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts
I_C	DC Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	PRE-IRRADIATION MIN.	TYP.	MAX.	POST-IRRADIATION (3 x 10^{14} nvt >10 keV) MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Note 4 and 5]	**15**	**16**		**15**	**22**		Volts	**I_C = 10 mA** $I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	40	48		40	45		Volts	$I_C = 10\ \mu A$ $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40			40			Volts	$I_C = 10\ \mu A$ $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5	6.0		4.5	6.0		Volts	$I_E = 10\ \mu A$ $I_C = 0$
h_{FE}	**DC Pulse Current Gain** [Note 5]	**110**	**120**	**150**	**19**	**21**			**I_C = 10 mA** $V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	70	80		15	17			I_C = 100 mA $V_{CE} = 1.0$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	35			6.0				I_C = 10 mA $V_{CE} = 1.0$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**7.0**	**9.4**		**6.0**	**8.0**			**I_C = 10 mA** V_{CE} = 10 V

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C), junction to ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C).
(4) Ratings refer to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle ≤2%.
(6) See switching circuits for exact value of I_C, I_{B1}, and I_{B2}.

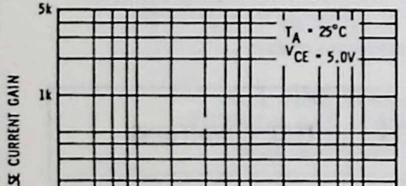
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

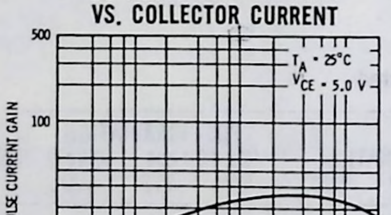
FAIRCHILD TRANSISTOR 2N4873

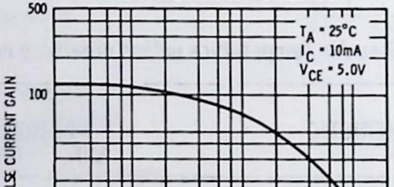
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

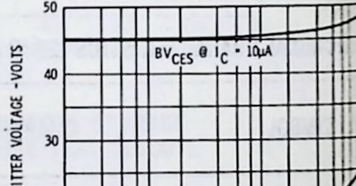
SYMBOL	CHARACTERISTIC	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST-IRRADIATION (3 x 10^{14} nvt >10 keV) MIN.	POST-IRRADIATION (3 x 10^{14} nvt >10 keV) TYP.	POST-IRRADIATION (3 x 10^{14} nvt >10 keV) MAX.	UNITS	TEST CONDITIONS	
V_{CE} (sat)	**Pulsed Collector Saturation Voltage [Note 5]**		**0.15**	**0.20**		**0.20**	**0.30**	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.13	0.18		0.17	0.28	Volts	I_C = 10 mA	I_B = 3.3 mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	0.72	0.80	0.87	0.72	0.81	0.87	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	0.74	0.85	1.0	0.74	0.85	1.0	Volts	I_C = 10 mA	I_B = 3.3 mA
I_{CES}	Collector Reverse Current		0.01	0.40		0.01	0.40	μA	V_{CE} = 20 V	V_{BE} = 0
C_{obo}	Common-Base, Open Circuit Output Capacitance			4.0			4.0	pF	V_{CB} = 5.0 V	I_E = 0
τ_S	**Charge Storage Time Constant** [Note 6]		**6.0**	**13**		**6.0**	**13**	ns	$I_C = I_{B1} \approx$ **10 ma**,	$I_{B2} \approx$ **−10 mA**
t_{on}	Turn On Time [Note 6]		9.0	12		10	13	ns	$I_C \approx$ 10 mA	$I_{B1} \approx$ 3.3 mA
t_{off}	Turn Off Time [Note 6]		13	18		12	18	ns	$I_C \approx$ 10 mA	$I_{B1} \approx$ 3.3 mA $I_{B2} \approx$ −3.3 mA
I_{CES} (125°C)	Collector Cutoff Current			50				μA	V_{CB} = 20 V	I_E = 0

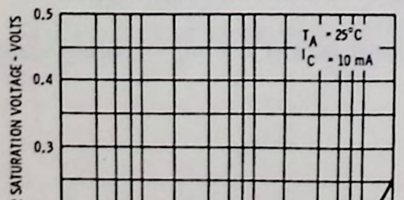
TYPICAL ELECTRICAL CHARACTERISTICS

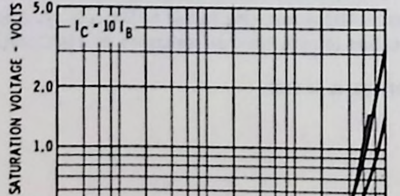

PRE-IRRADIATION DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

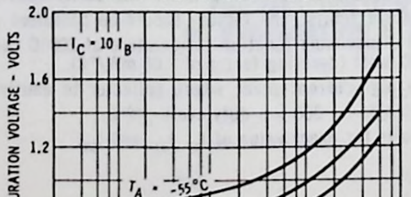

POST-IRRADIATION (3 x 10^{14} nvt >10 keV) DC PULSE CURRENT GAIN VS. COLLECTOR CURRENT


DC PULSE CURRENT GAIN VERSUS FAST NEUTRON DOSAGE


COLLECTOR TO EMITTER VOLTA VERSUS FAST NEUTRON DOSA


COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE

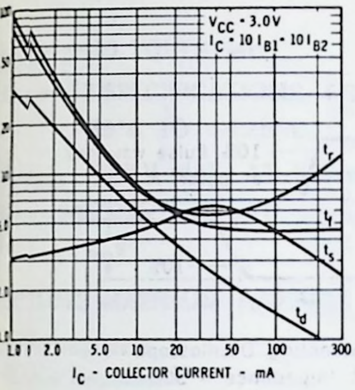

COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

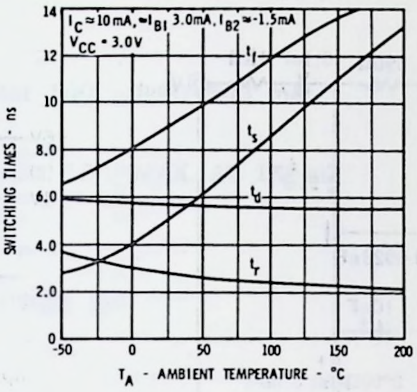
FAIRCHILD TRANSISTOR 2N4873

TYPICAL ELECTRICAL CHARACTERISTICS

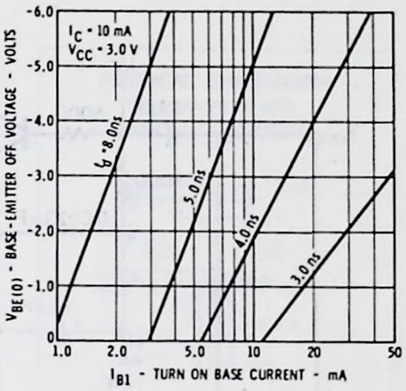
SWITCHING TIMES VERSUS COLLECTOR CURRENT



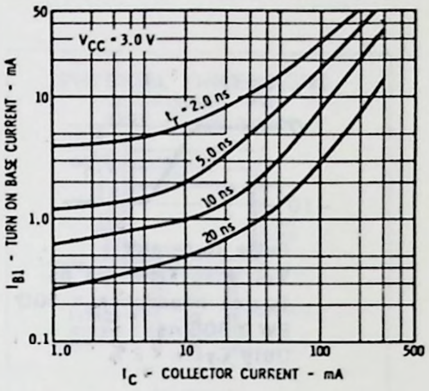
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



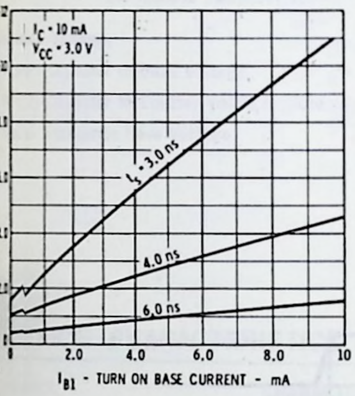
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



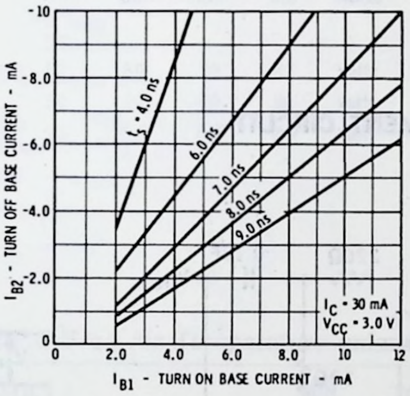
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



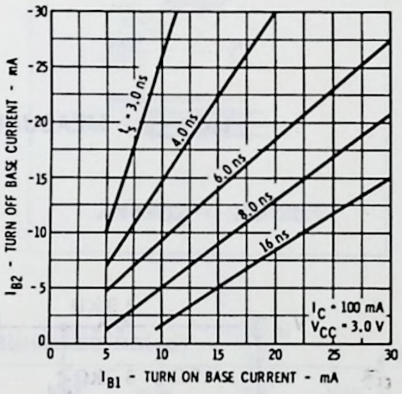
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



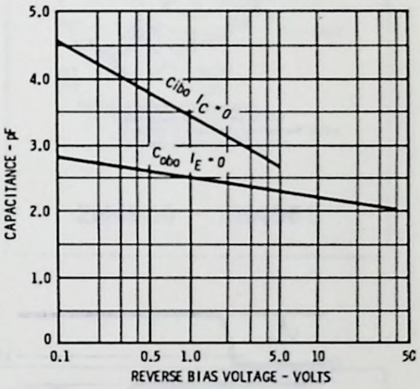
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



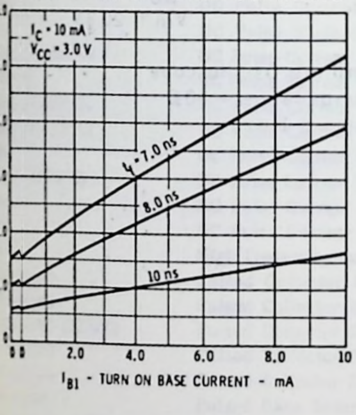
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



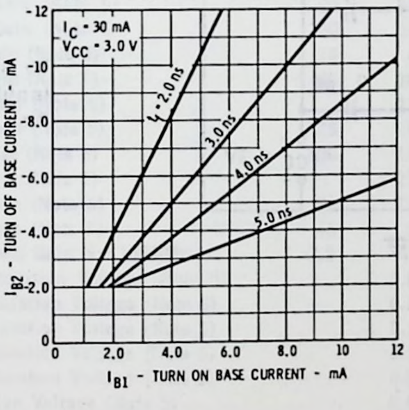
EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



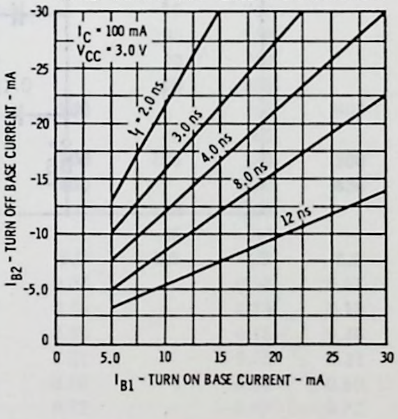
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



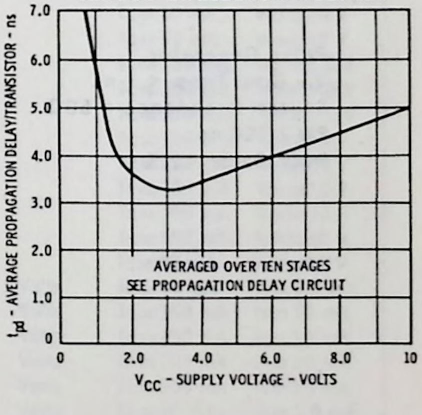
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



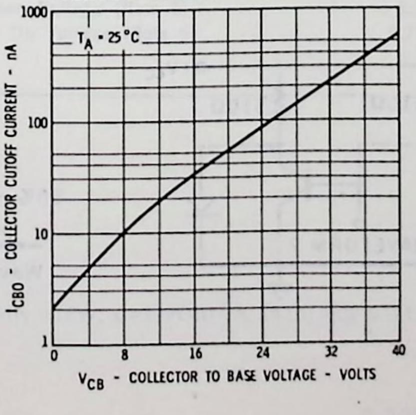
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



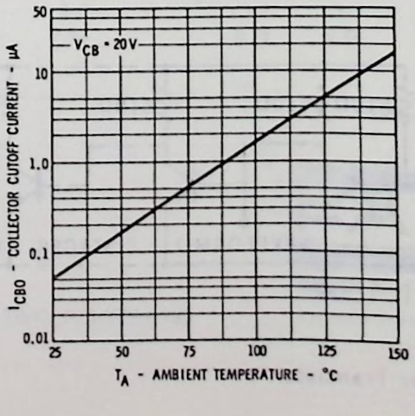
AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE



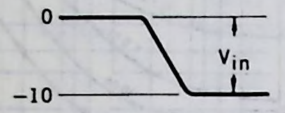
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



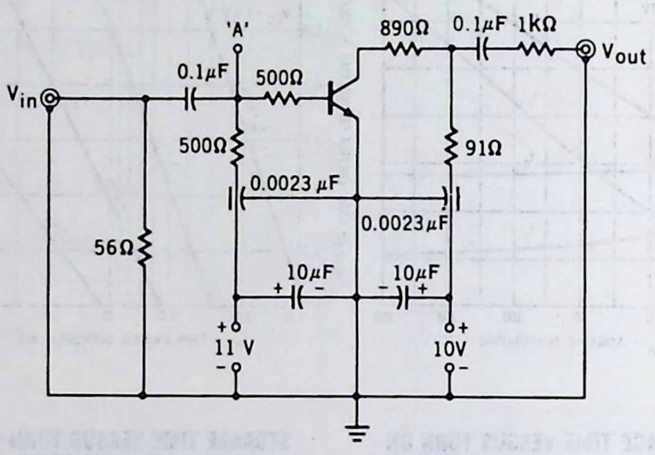
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE

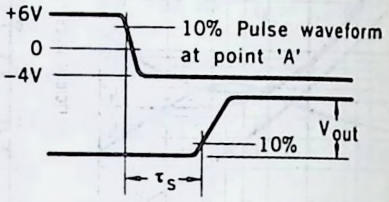


CHARGE STORAGE TIME MEASUREMENT CIRCUIT



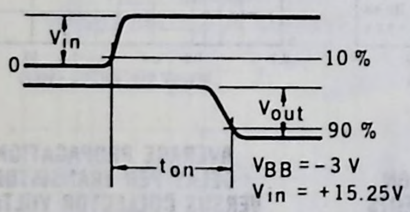
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %


V_{in}
0.1μF
'A'
500Ω
890Ω
0.1μF
1kΩ
V_{out}
500Ω
91Ω
0.0023 μF
0.0023 μF
56Ω
10μF
10μF
11 V
10V

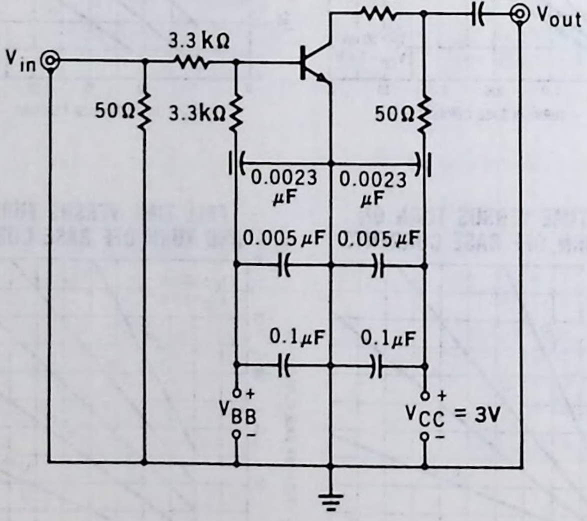

+6V
0
-4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_S

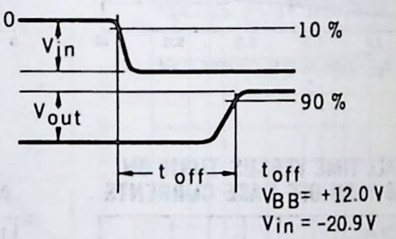
To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT


V_{in}
0
10 %
V_{out}
90 %
t_{on}
$V_{BB} = -3$ V
$V_{in} = +15.25$V

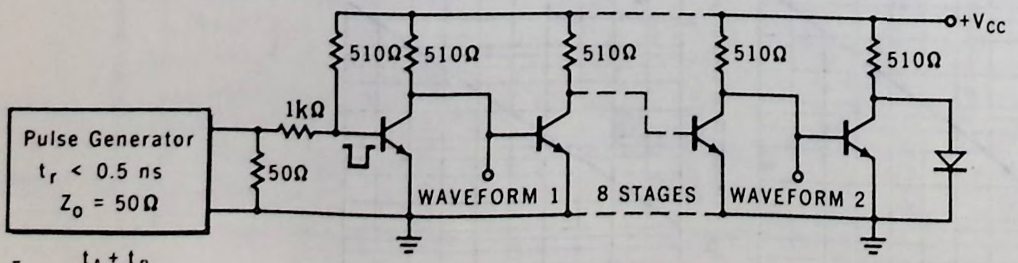
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %


V_{in}
3.3 kΩ
220Ω
0.1μF
V_{out}
50Ω
3.3kΩ
50Ω
0.0023 μF
0.0023 μF
0.005 μF
0.005 μF
0.1μF
0.1μF
V_{BB}
V_{CC} = 3V


0
10 %
V_{in}
90 %
V_{out}
t_{off}
t_{off}
V_{BB}= +12.0 V
V_{in} = -20.9 V

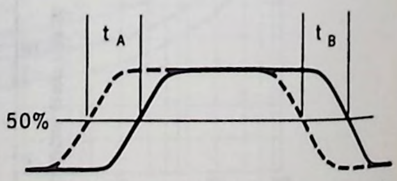
To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY


Pulse Generator
t_r < 0.5 ns
Z_0 = 50 Ω
1kΩ
50Ω
510Ω
510Ω
510Ω
510Ω
510Ω
+V_{CC}
WAVEFORM 1
8 STAGES
WAVEFORM 2

$$\bar{t}pd = \frac{t_A + t_B}{20}$$

$\bar{t}pd$ = Average Propagation per Transistor



Waveforms 1 and 2 Superimposed

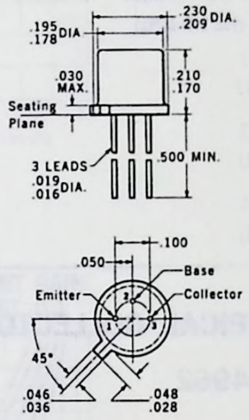
2N4960 · 2N4961 · 2N4962 · 2N4963

NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} -- 80 VOLTS MIN.
- h_{FE} -- 12 SPECIFICATIONS FROM 100 μA TO 500 mA; −55°C TO +125°C
- $V_{CE(sat)}$ -- 0.5 V MAX. AT 500 mA; 0.18 V MAX. AT 150 mA
- f_T -- 250 MHz MIN. AT 50 mA

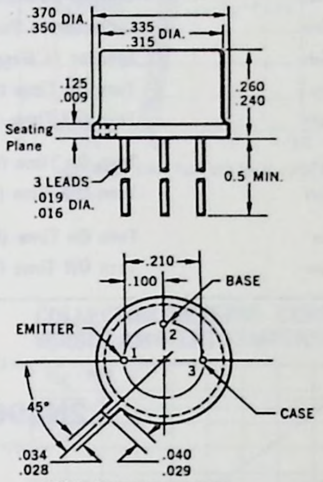
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.43 gram

2N4962 · 2N4963

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold-plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

2N4960 · 2N4961

ABSOLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures					
Storage Temperature	−65°C to +200°C				
Operating Junction Temperature	+200°C				
aximum Power Dissipation (Note 2 & 3)	2N4960	2N4961	2N4962	2N4963	
Total Dissipation at Case Temperature, 25°C	3.5	3.5	1.5	1.5	Watts
at Ambient Temperature, 25°C	0.8	0.8	0.5	0.5	Watts
aximum Voltages					
V_{CBO} Collector to Base Voltage	60	80	60	80	Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	60	80	60	80	Volts
V_{EBO} Emitter to Base Voltage	6.5	6.5	6.5	6.5	Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	30	60		30	60			I_C=100μA	V_{CE}=10 V
h_{FE}	DC Current Gain	60	100		60	100			I_C=1.0 mA	V_{CE}=10 V
h_{FE}	DC Pulse Current Gain (Note 5)	90	140		90	140			I_C=10 mA	V_{CE}=10 V
h_{FE}	DC Pulse Current Gain (Note 5)	100	150		100	150			I_C=50 mA	V_{CE}=10 V
h_{FE} (−55°C)	**DC Pulse Current Gain (Note 5)**	**10**	**40**		**10**	**40**			**I_C=150 mA**	**V_{CE}=1.0 V**
h_{FE}	**DC Pulse Current Gain (Note 5)**	**40**	**100**		**40**	**100**			**I_C=150 mA**	**V_{CE}=1.0 V**
h_{FE} (125°C)	DC Pulse Current Gain (Note 5)		130	500		130	500		I_C=150 mA	V_{CE}=1.0 V
h_{FE} (−55°C)	DC Pulse Current Gain (Note 5)	25	60		25	60			I_C=150 mA	V_{CE}=10 V
h_{FE}	**DC Pulse Current Gain (Note 5)**	**100**	**180**	**300**	**100**	**180**	**300**		**I_C=150 mA**	**V_{CE}=10 V**
h_{FE} (125°C)	**DC Pulse Current Gain (Note 5)**		**270**	**650**		**270**	**650**		**I_C=150 mA**	**V_{CE}=10 V**
h_{FE}	DC Pulse Current Gain (Note 5)	70	100		70	100			I_C=300 mA	V_{CE}=10 V
h_{FE}	DC Pulse Current Gain (Note 5)	45	60		45	60			I_C=500 mA	V_{CE}=10 V
h_{fe}	**High Frequency Current Gain (f=100MHz)**	**2.5**	**4.0**	**6.0**	**2.5**	**4.0**	**6.0**		**I_C=50 mA**	**V_{CE}=10 V**
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.04	0.07		0.04	0.07	Volts	I_C=10 mA	I_B=1.0 mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage (Note 5)**		**0.15**	**0.18**		**0.15**	**0.18**	**Volts**	**I_C=150 mA**	**I_B=15 mA**
V_{CE}(sat) (125°C)	Pulsed Collector Saturation Voltage (Note 5)		0.18	0.36		0.18	0.36	Volts	I_C=150 mA	I_B=15 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.25	0.31		0.25	0.31	Volts	I_C=300 mA	I_B=30 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.38	0.50		0.38	0.50	Volts	I_C=500 mA	I_B=50 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		0.67	0.72		0.67	0.72	Volts	I_C=10 mA	I_B=1.0 mA
V_{BE}(sat)(−55°C)	**Pulsed Base Saturation Voltage (Note 5)**		**0.92**	**1.10**		**0.92**	**1.10**	**Volts**	**I_C=150 mA**	**I_B=15 mA**
V_{BE}(sat)	**Pulsed Base Saturation Voltage (Note 5)**	**0.78**	**0.82**	**0.90**	**0.78**	**0.82**	**0.90**	**Volts**	**I_C=150 mA**	**I_B=15 mA**
V_{BE}(sat)(125°C)	**Pulsed Base Saturation Voltage (Note 5)**	**0.63**	**0.73**		**0.63**	**0.73**		**Volts**	**I_C=150 mA**	**I_B=15 mA**
V_{BE}(sat)	**Pulsed Base Saturation Voltage (Note 5)**		**0.95**	**1.05**		**0.95**	**1.05**	**Volts**	**I_C=300 mA**	**I_B=30 mA**
V_{BE}(sat)	**Pulsed Base Saturation Voltage (Note 5)**		**1.1**	**1.3**		**1.1**	**1.3**	**Volts**	**I_C=500 mA**	**I_B=50 mA**
V_{BE}(on)	Pulsed Base Emitter On Voltage (Note 5)		0.75	0.88		0.75	0.88	Volts	I_C=150 mA	V_{CE}=10 V

*Planar is a patented Fairchild process.

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SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS 2N4960 • 2N4961 • 2N4962 • 2N4963

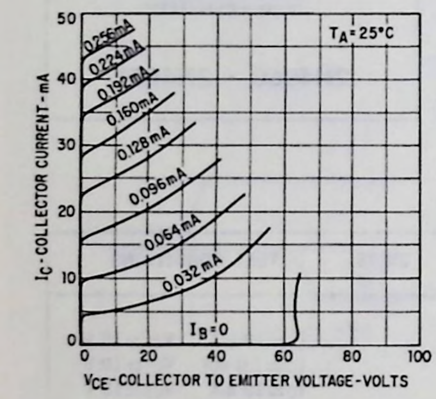
ELECTRICAL CHARACTERISTICS (25° Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4960 • 2N4962 MIN.	TYP.	MAX.	2N4961 • 2N4963 MIN	TYP.	MAX.	UNIT	TEST CONDITIONS	
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage (Note 4 & 5)**	60			80			Volts	$I_C = 10$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	60			80			Volts	$I_C = 10\ \mu A$	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60			80			Volts	$I_C = 10\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.5			6.5			Volts	$I_C = 0$	$I_E = 10\ \mu A$
I_{CBO}	Collector Cutoff Current		1.0	10		1.0	10	nA	$I_E = 0$	$V_{CB} = 50$ V
I_{CBO}(125°C)	Collector Cutoff Current		1.0	10		1.0	10	μA	$I_E = 0$	$V_{CB} = 50$ V
I_{EBO}	Emitter Cutoff Current		1.0	10		1.0	10	nA	$I_C = 0$	$V_{EB} = 4.0$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		11	15		11	15	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		50	75		50	75	pF	$I_C = 0$	$V_{EB} = 0.5$ V
t_{on}	Turn On Time (Note 6, Fig. 1)		70	150		70	150	ns	$I_C \approx 150$ mA	$I_{B1} \approx 15$ mA
t_{off}	Turn Off Time (Note 6, Fig. 1)		700	1000		700	1000	ns	$I_C \approx 150$ mA	$I_{B1} \approx 15$ mA $I_{B2} \approx -15$ mA
t_{on}	Turn On Time (Note 6, Fig. 1)		80			80		ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	Turn Off Time (Note 6, Fig. 1)		600			600		ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA $I_{B2} \approx -30$ mA
t_{on}	Turn On Time (Note 6, Fig. 1)		100			100		ns	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA
t_{off}	Turn Off Time (Note 6, Fig. 1)		500			500		ns	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA $I_{B2} \approx -50$ mA

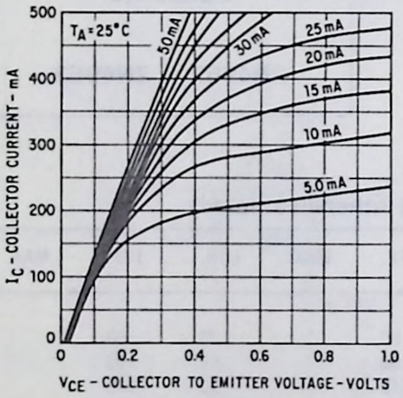
TYPICAL COLLECTOR AND BASE CHARACTERISTICS

2N4960 · 2N4962

ACTIVE REGION



SATURATION REGION



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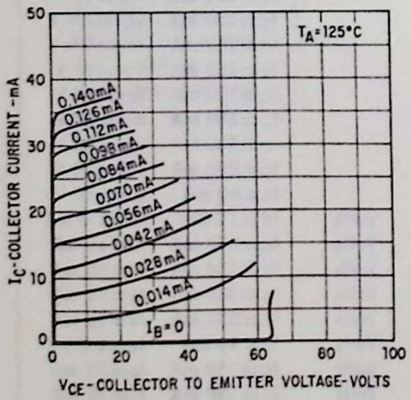

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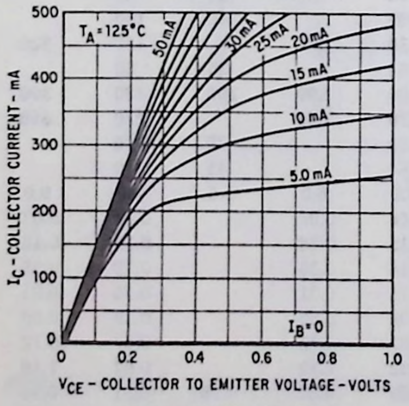

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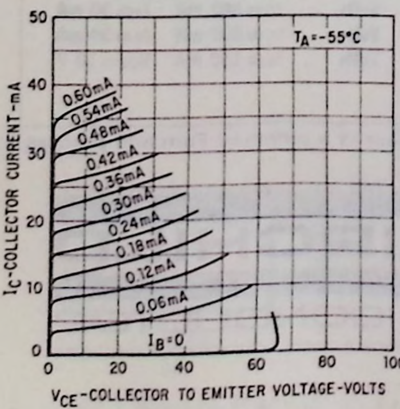

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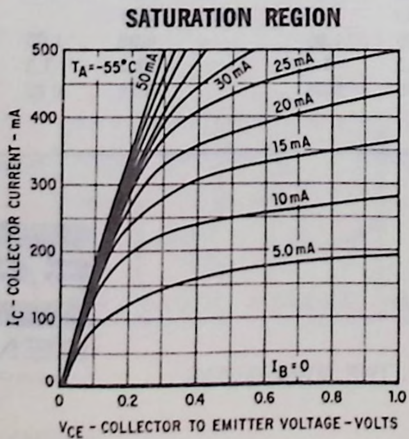
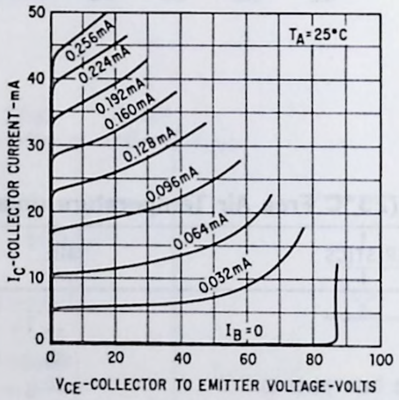


2N4961 · 2N4963

ACTIVE REGION



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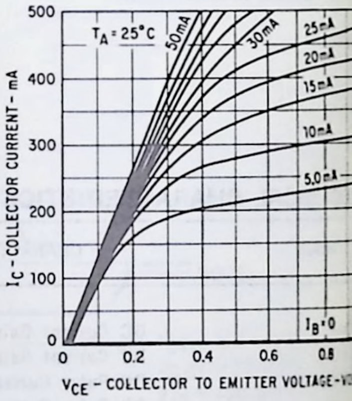

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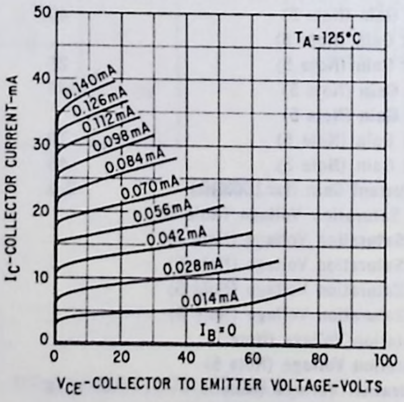

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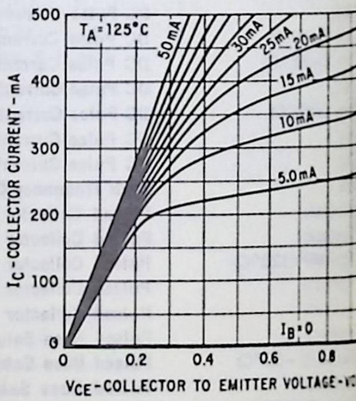
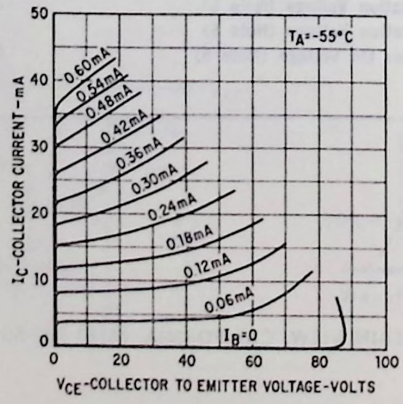


ACTIVE REGION



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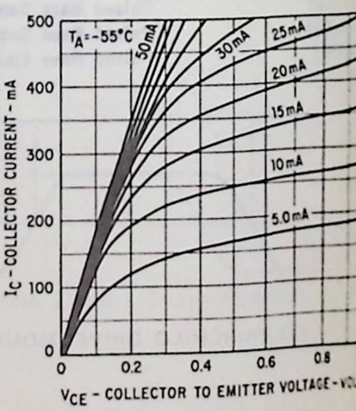
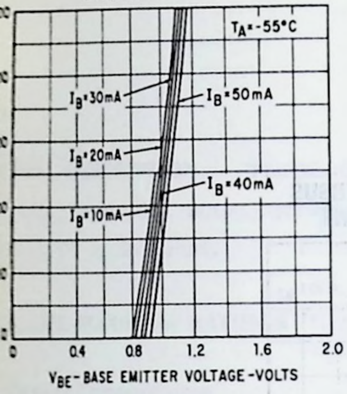
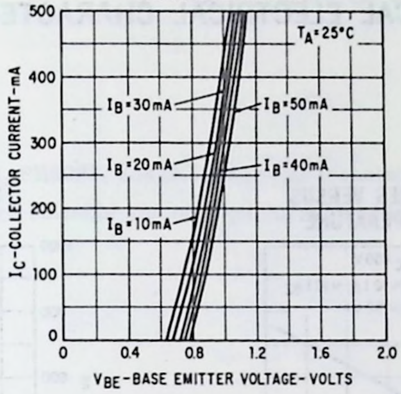


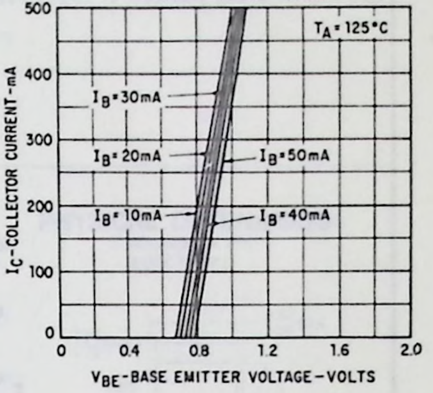
TYPICAL ELECTRICAL CHARACTERISTICS



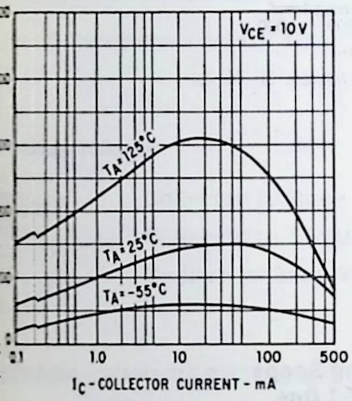
TYPICAL BASE CHARACTERISTICS



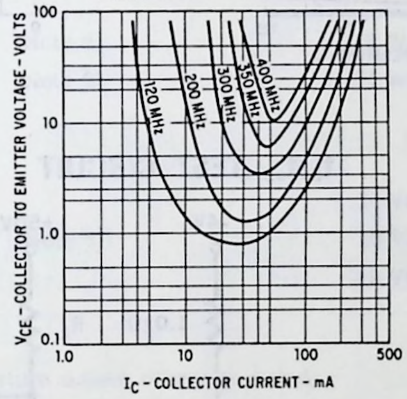
TYPICAL BASE CHARACTERISTICS



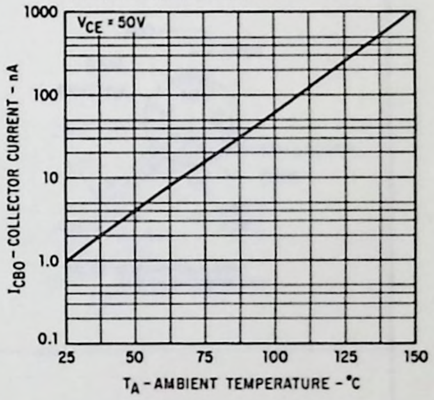
TYPICAL BASE CHARACTERISTICS



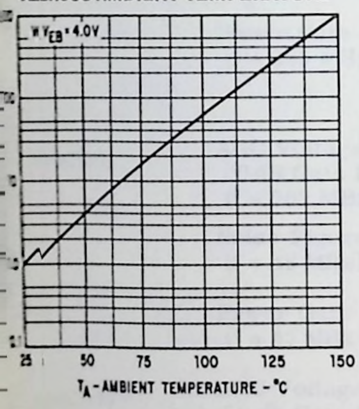
DC PULSE CURRENT GAIN VERSUS COLLECTOR VOLTAGE



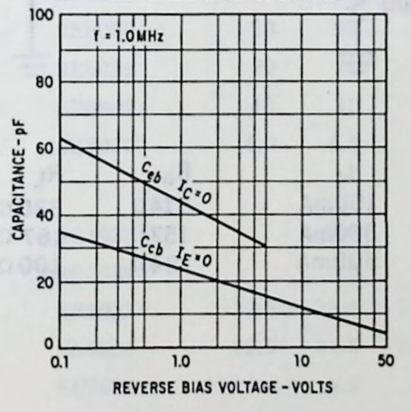
CONTOUR OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



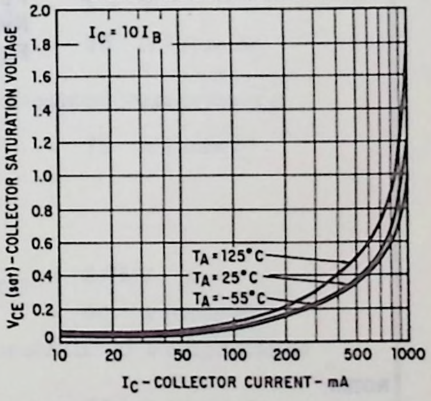
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



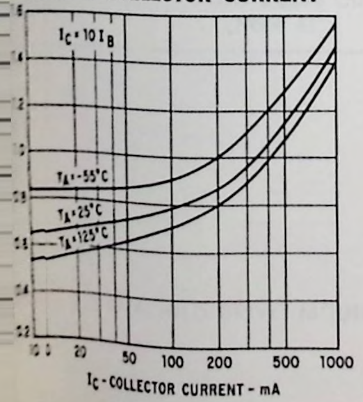
EMITTER CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



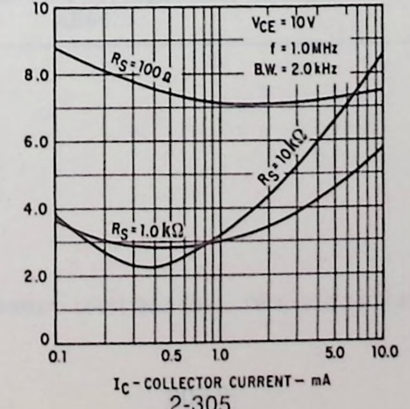
COLLECTOR-BASE AND EMITTER-BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



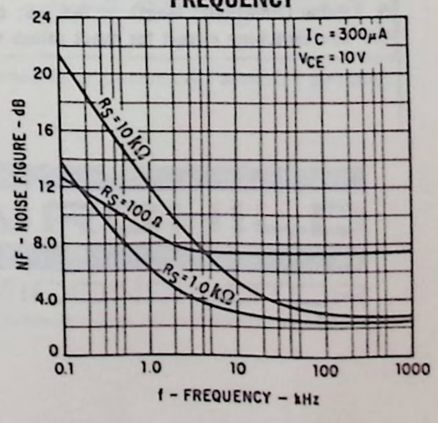
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

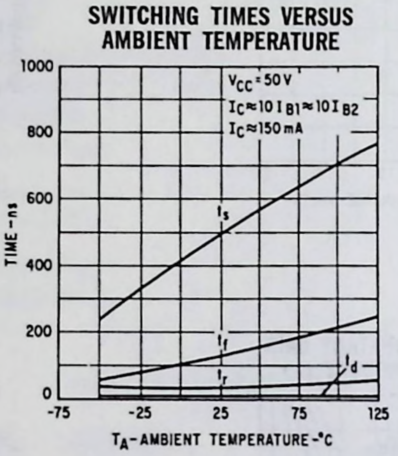


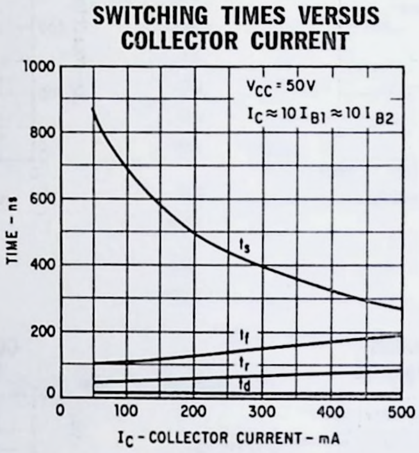
NOISE FIGURE VERSUS COLLECTOR CURRENT



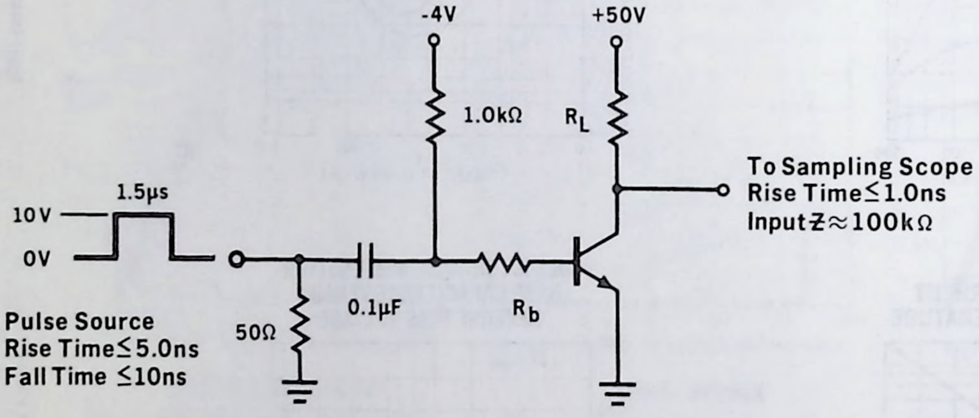
NOISE FIGURE VERSUS FREQUENCY

TYPICAL ELECTRICAL CHARACTERISTICS


SWITCHING TIMES VERSUS AMBIENT TEMPERATURE


SWITCHING TIMES VERSUS COLLECTOR CURRENT

t_{on}-t_{off} TEST CIRCUIT


-4V
+50V
1.0kΩ
R_L
To Sampling Scope
Rise Time ≤ 1.0ns
Input Z ≈ 100kΩ
1.5µs
10 V
0V
0.1µF
R_b
50Ω
Pulse Source
Rise Time ≤ 5.0ns
Fall Time ≤ 10ns

I_C	R_b	R_L
150mA	314Ω	330Ω
300mA	157Ω	167Ω
500mA	94Ω	100Ω

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C) for the 2N49 2N4961; 117°C/Watt (derating factor of 8.6 mW/°C) for the 2N4962 and 2N4963 . Junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.6 mW/°C the 2N4960 and 2N4961 350°C/Watt derating factor of 2.9 mW/°C) for the 2N4962 and 2N4963 .
4. Rating refers to a high-current point where collector-to-emitter voltage is lowest.
5. Pulse Conditions: length = 300 µS; duty cycle = 1%.
6. See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

SE5020 · SE5021 · SE5022 · SE5023 · SE5024

NPN RF-AGC AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

ENERAL DESCRIPTION – The SE5020, SE5021, SE5022, SE5023, and SE5024 are RF transistors th gain, bandwidth, noise characteristics, and package suitable for high-performance, high-ability TV applications.

SOLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures

Storage Temperature	-55°C to +175°C
Operating Junction Temperature	175°C Maximum

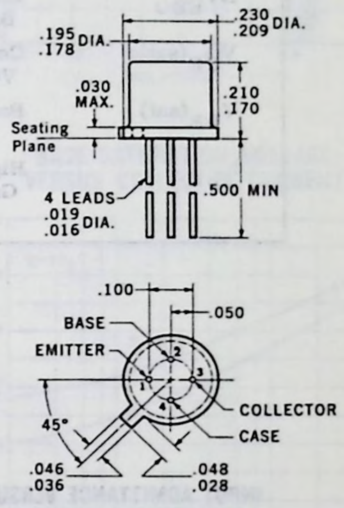
aximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Note 2)	0.260 Watt
at 25°C Ambient Temperature	(Note 2)	0.175 Watt

aximum Voltages

V_{CBO}	Collector to Base Voltage		20 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 3)	20 Volts
V_{EBO}	Emitter to Base Voltage		3.0 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-72)



NOTES: All dimensions in inches
Leads are gold-plated kovar

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic		Min.	Typ.	Max.	Units	Test Conditions
NF	Noise Figure (f = 200 MHz)	SE5020		2.8	3.3	dB	V_{AGC} = 1.4 V R_S = 75 Ω (Note 5) Neutralized Performance
		SE5021		3.5	4.0	dB	
PG	Power Gain (f = 200 MHz)	SE5020	20	25	27	dB	
		SE5021	20	25	27	dB	
		SE5022	18	21		dB	
$V_{AGC(30)}$	AGC Voltage for 30 dB Gain Reduction (f = 200 MHz)	SE5020	4.0	4.5	5.0	Volts	R_S = 75 Ω (Note 5)
NF	Noise Figure (f = 45 MHz)	SE5023		3.0	6.0	dB	V_{AGC} = 2.75 V R_S = 50 Ω (Note 6) Unneutralized Performance
		SE5024		3.0	6.0	dB	
PG	Power Gain (f = 45 MHz)	SE5023	22.5	25.5	28.5	dB	
		SE5024	22.5	25.5	28.5	dB	
$V_{AGC(30)}$	AGC Voltage for 30 db Gain Reduction (f = 45 MHz)	SE5023	4.4	4.9	5.4	Volts	R_S = 50 Ω (Note 6)
		SE5024	5.2	5.7	6.2	Volts	
C_{re}	Reverse Transfer Capacity, Common Emitter	SE5020 through SE5024	0.25	0.37	0.5	pF	$I_E = 0$, V_{CB} = 10 V, f = 1.0 MHz (Emitter and can guarded)
h_{FE}	DC Pulse Current Gain (Note 4)	SE5020 through SE5024	20	40	200		I_C = 4.0 mA, V_{CE} = 5.0 V

*Planar is a patented Fairchild process.

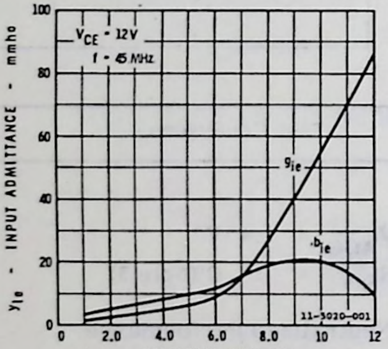
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

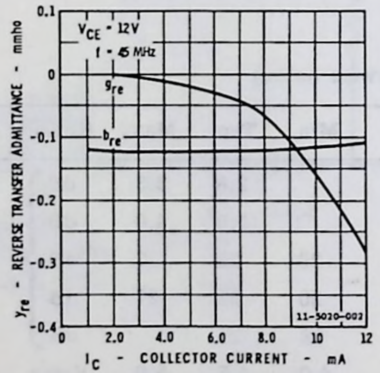
Symbol	Characteristic		Min.	Typ.	Max.	Units	Test Conditions
I_{CBO}	Collector Cutoff Current	SE5020 through SE5024			50	nA	I_E = 0 V_{CB} = 10 V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	SE5020 through SE5024	20			Volts	I_C = 1.0 mA I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	SE5020 through SE5024	20			Volts	I_C = 100 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	SE5020 through SE5024	3.0			Volts	I_C = 0 I_E = 100 μA
V_{CE}(sat)	Collector Saturation Voltage	SE5020 through SE5024			3.0	Volts	I_C = 10 mA I_B = 5.0 mA
V_{BE}(sat)	Base Saturation Voltage	SE5020 through SE5024			0.96	Volts	I_C = 10 mA I_B = 5.0 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	SE5020 · SE5021	3.75	5.0	8.0		I_C = 4.0 mA V_{CE} = 10 V
		SE5022 through SE5024	3.0	4.5	8.0		

TYPICAL SMALL SIGNAL "Y" PARAMETERS COMMON EMITTER

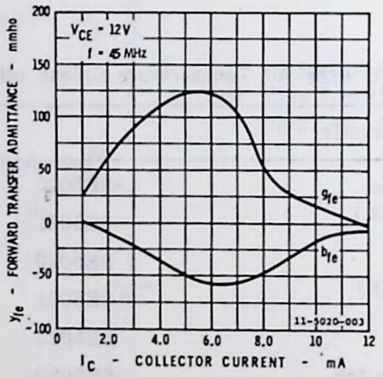
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



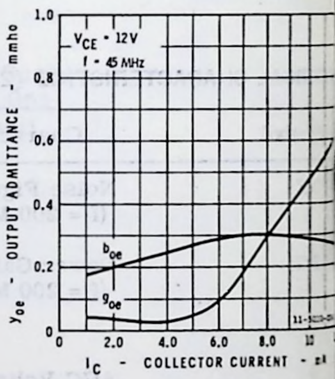
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



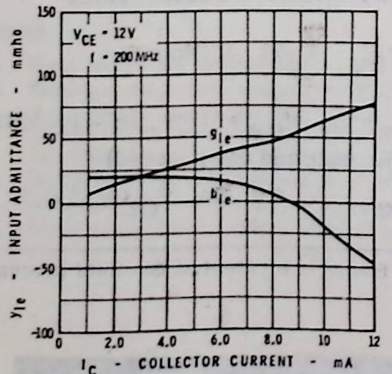
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



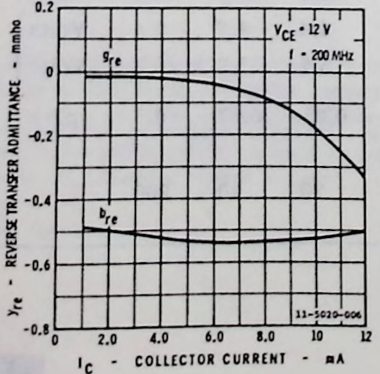
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



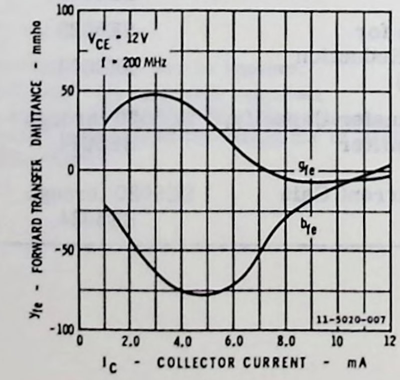
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



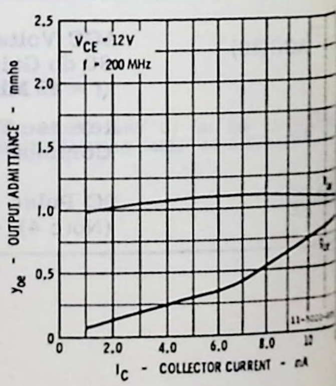
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT

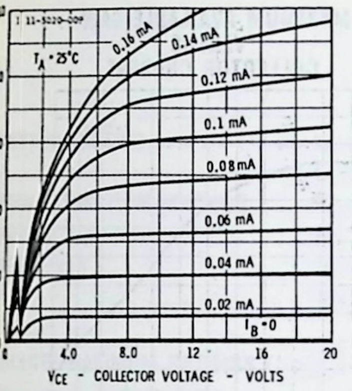


OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT

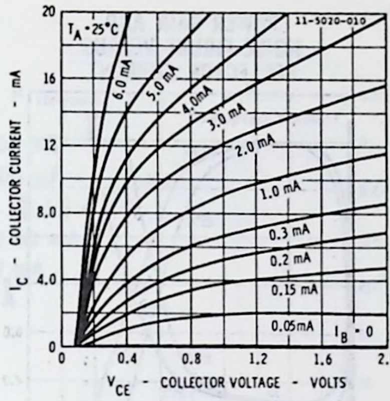


TYPICAL ELECTRICAL CHARACTERISTICS

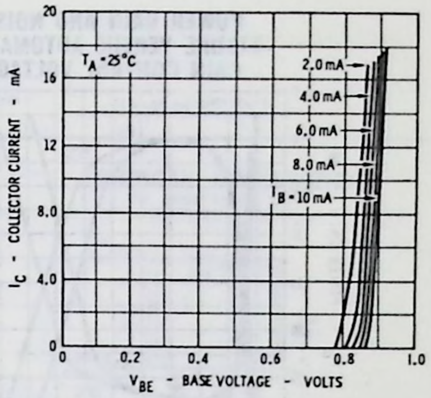
COLLECTOR CHARACTERISTICS*



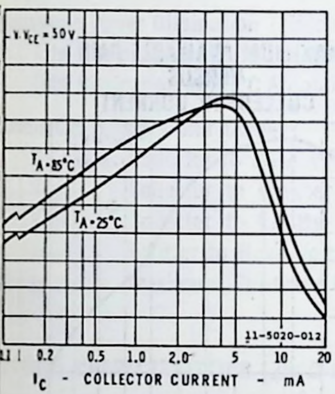
COLLECTOR CHARACTERISTICS*



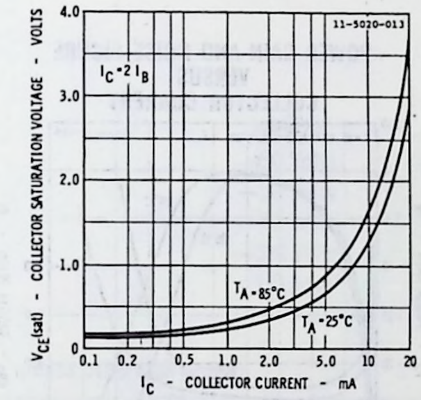
BASE CHARACTERISTICS*



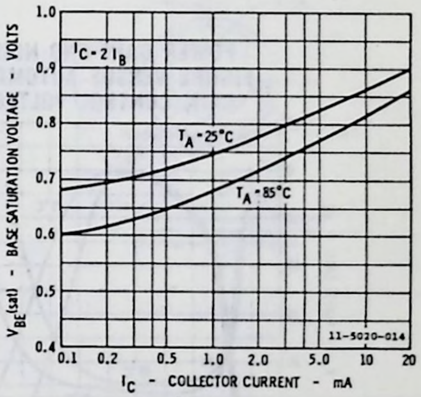
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



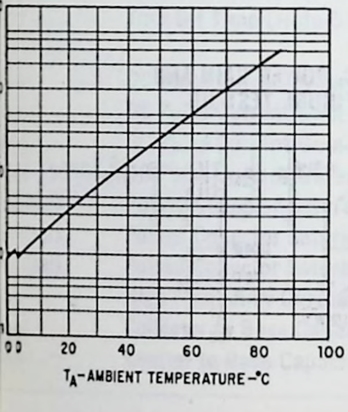
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



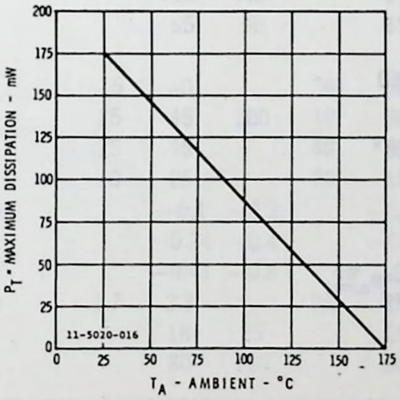
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



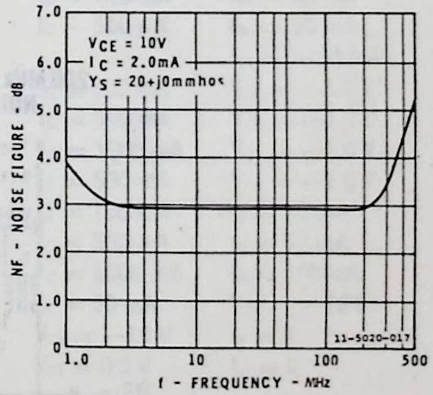
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



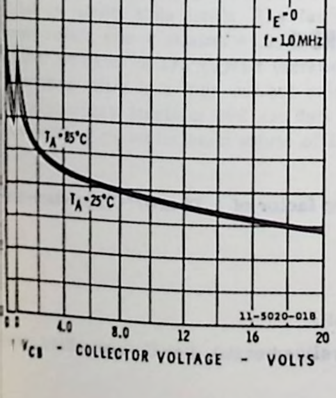
MAXIMUM DISSIPATION VERSUS TEMPERATURE



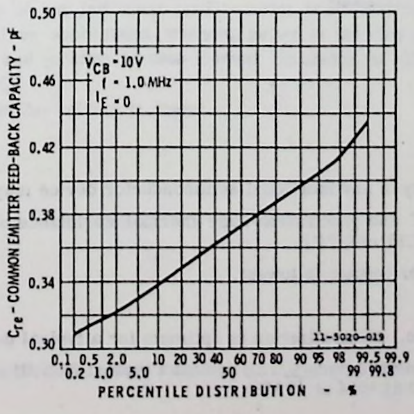
NOISE FIGURE VERSUS FREQUENCY



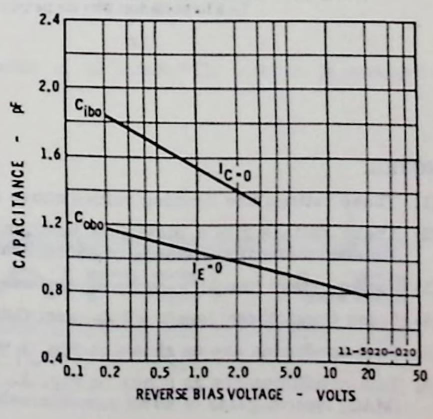
COMMON EMITTER FEED-BACK CAPACITY VERSUS COLLECTOR VOLTAGE



DISTRIBUTION OF COMMON EMITTER FEED-BACK CAPACITY



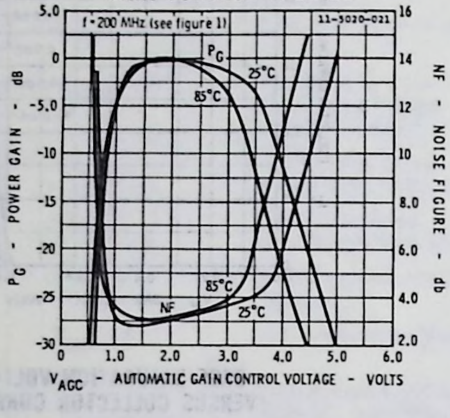
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



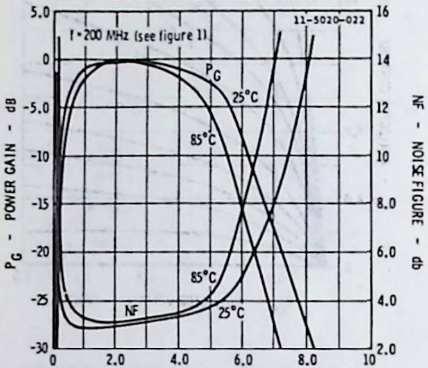
ngle family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

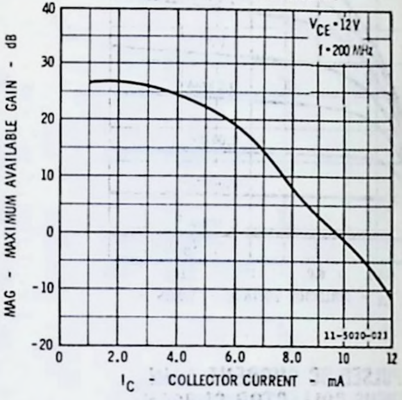
POWER GAIN AND NOISE FIGURE VERSUS AUTOMATIC GAIN CONTROL VOLTAGE



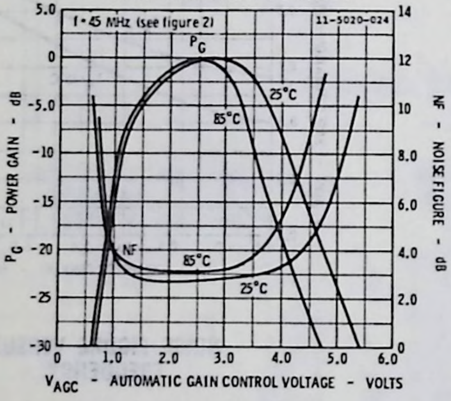
POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



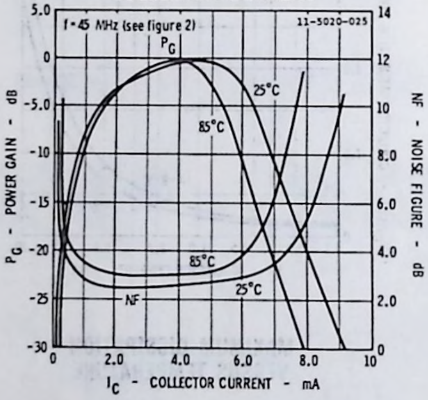
MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



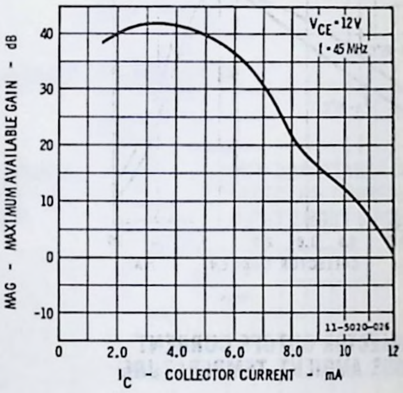
POWER GAIN AND NOISE FIGURE VERSUS AUTOMATIC GAIN CONTROL VOLTAGE



POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



200 MHz AGC, POWER GAIN AND NOISE FIGURE TEST JIG

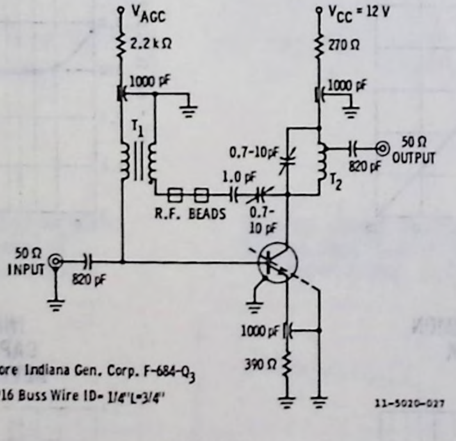

V_AGC
2.2 kΩ
1000 pF
T_1
R.F. BEADS
V_CC = 12 V
270 Ω
1000 pF
0.7-10 pF
1.0 pF
0.7-10 pF
T_2
820 pF
50 Ω OUTPUT
50 Ω INPUT
820 pF
1000 pF
390 Ω
T_1: Ferrite Core Indiana Gen. Corp. F-684-Q_3
T_2: 6 Turns #16 Buss Wire ID- 1/4" L=3/4"
11-5020-027

FIGURE 1

45 MHz, AGC, POWER GAIN AND NOISE FIGURE TEST JIG

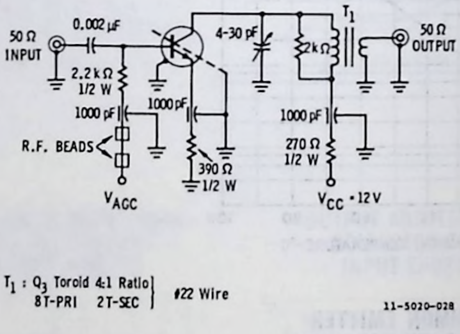

50 Ω INPUT
0.002 µF
2.2 kΩ 1/2 W
1000 pF
R.F. BEADS
V_AGC
1000 pF
390 Ω 1/2 W
4-30 pF
2 kΩ
T_1
50 Ω OUTPUT
1000 pF
270 Ω 1/2 W
V_CC = 12 V
T_1 : Q_3 Toroid 4:1 Ratio 8T-PRI 2T-SEC #22 Wire
11-5020-028

FIGURE 2

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 583°C/Watt (derating factor of 1.73 mW/°C); junction-t ambient thermal resistance of 850°C/Watt (derating factor of 1.17 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(4) Pulse Conditions: length = 300 µsec; duty cycle = 1%.

(5) Test conditions are as shown on Fig. 1 with fixed neutralization. Neutralization is optimum for a typical device with $C_{re} \simeq 0.37$ pF.

(6) Test conditions are as shown on Fig. 2. This test assures gain variations ≤ 3 dB around a typical 25.5 dB nominal for the unneutralized case. For the neutralized ca (MAG) typical gains of 40 dB are obtainable with the SE5023 and SE5024 at 45 MHz.

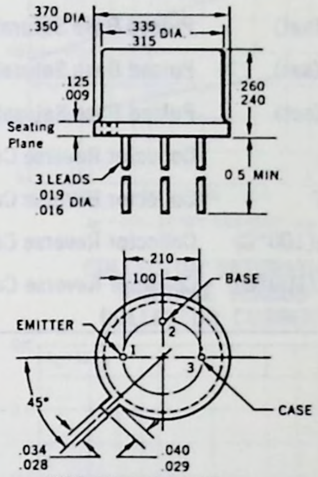
2N5022 · 2N5023

PNP HIGH VOLTAGE, HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FAST SWITCHING . . . . **t_{on} = 25 ns (TYP) @ 500 mA**
. . . . **t_{off} = 65 ns (TYP) @ 500 mA**
LOW SATURATION VOLTAGE . . . **V_{CE}(sat) = 0.7 V (MAX) @ 1.0 A**
HIGH FREQUENCY . . . . **f_T = 200 MHz (MIN) @ 50 mA**
HIGH BETA . . . . **h_{FE} = 40 − 100 @ 500 mA**
. . . . **h_{FE} = 40 (MIN) @ 1.0 A**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES All dimensions in inches
Leads are gold plated KOVAR
Lead No 3 internally connected to case
Package weight is 1 23 grams

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation (Note 2 and 3)

Total Dissipation at 25°C Case Temperature	4.0 Watts
Total Dissipation at 25°C Ambient Temperature	1.0 Watt

Maximum Voltages and Current		**2N5022**	**2N5023**
V_{CBO}	Collector to Base Voltage	−50 Volts	−30 Volts
V_{CES}	Collector to Emitter Voltage	−50 Volts	−30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−50 Volts	−30 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C	Maximum Collector Current (Note 5)	1.0 Amp	1.0 Amp

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

			2N5022			2N5023				
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
t_{on}	**Turn On Time** (Note 6)		25	40		25	40	ns	I_C ≈ 500 mA	I_{B1} ≈ 50 mA
t_{off}	**Turn Off Time** (Note 6)		65	90		65	90	ns	I_C ≈ 500 mA	I_{B1} ≈ 50 mA I_{B2} ≈ −50 mA
h_{FE}	DC Pulse Current Gain (Note 5)	15	40		30	50			I_C = 100 mA	V_{CE} = −1.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	25	45	100	40	60	100		I_C = 500 mA	V_{CE} = −1.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	25	45		40	60			I_C = 1000 mA	V_{CE} = −5.0 V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	10	25		20	45			I_C = 500 mA	V_{CE} = −1.0 V
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.1	−0.2		−0.09	−0.17	Volts	I_C = 100 mA	I_B = 10 mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.24	−0.4		−0.19	−0.35	Volts	I_C = 500 mA	I_B = 50 mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		−0.41	−0.8		−0.3	−0.7	Volts	I_C = 1000 mA	I_B = 100 mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	1.7	2.3		2.0	2.8			I_C = 50 mA	V_{CE} = −10 V
C_{ob}	Collector to Base Capacitance		18	25		20	25	pF	V_{CB} = −10 V	I_E = 0
C_{eb}	Emitter to Base Capacitance		80	100		80	100	pF	V_{BE} = 0.5 V	I_C = 0

*Planar is a patented Fairchild process.

TES:
These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.8°C/Watt (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 175°C/Watt (derating factor of 5.72 mW/°C).
This rating refers to a high current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.
See switching circuit for exact values of I_C, I_B, and I_{B2}.

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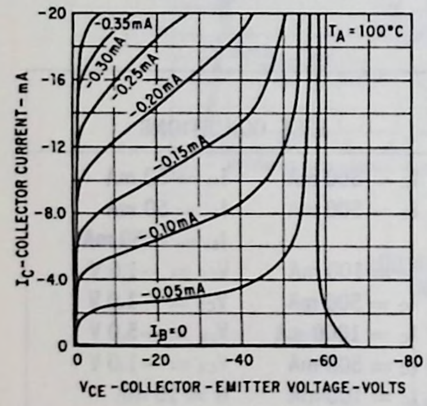
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

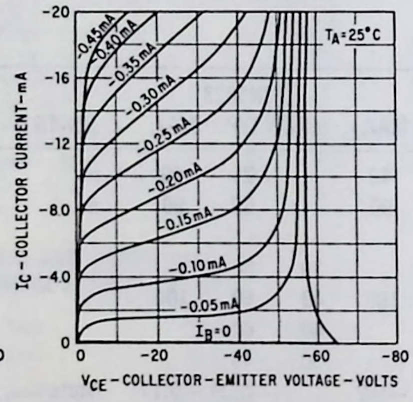
SYMBOL	CHARACTERISTIC	2N5022 MIN.	2N5022 TYP.	2N5022 MAX.	2N5023 MIN.	2N5023 TYP.	2N5023 MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 4 and 5)	−50			−30			Volts	$I_C = 10$ mA	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−50			−30			Volts	$I_C = 100\ \mu A$	$I_E = 0$
BV_{CES}	Collector to Base Breakdown Voltage	−50			−30			Volts	$I_C = 100\ \mu A$	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			Volts	$I_E = 100\ \mu A$	$I_C = 0$
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.8	−1.0		−0.8	−1.0	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)	−0.9	−1.02	−1.4	−0.9	−1.02	−1.4	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−1.2	−1.75		−1.2	−1.75	Volts	$I_C = 1000$ mA	$I_B = 100$ mA
I_{CES}	Collector Reverse Current		10	100				nA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CES}	Collector Reverse Current					8.0	100	nA	$V_{CE} = -20$ V	$V_{BE} = 0$
I_{CES}(100°C)	Collector Reverse Current		1.5	15				μA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CES}(100°C)	Collector Reverse Current					1.0	15	μA	$V_{CE} = -20$ V	$V_{BE} = 0$

2N5022

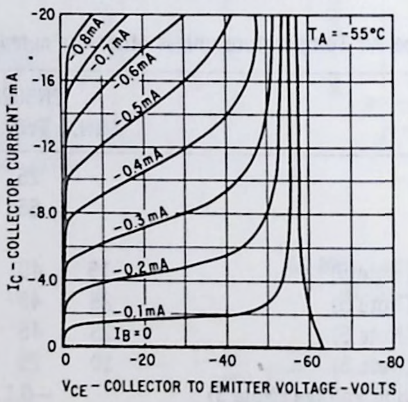
COLLECTOR CHARACTERISTICS



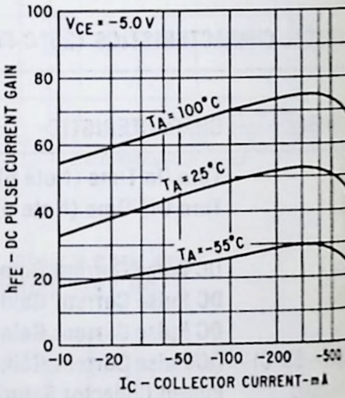
COLLECTOR CHARACTERISTICS



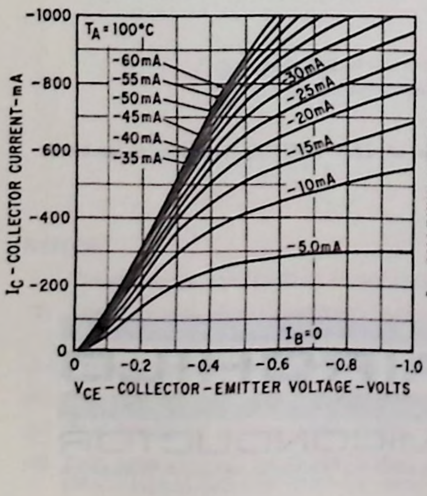
COLLECTOR CHARACTERISTICS



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURREN



COLLECTOR CHARACTERISTICS



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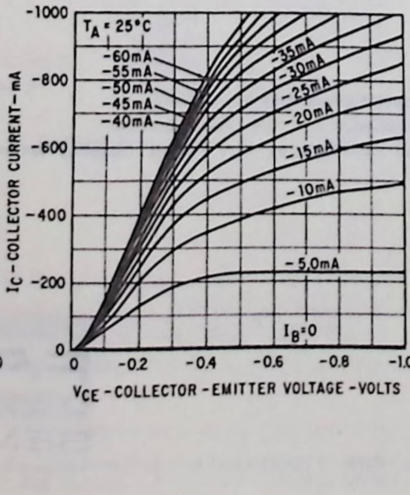
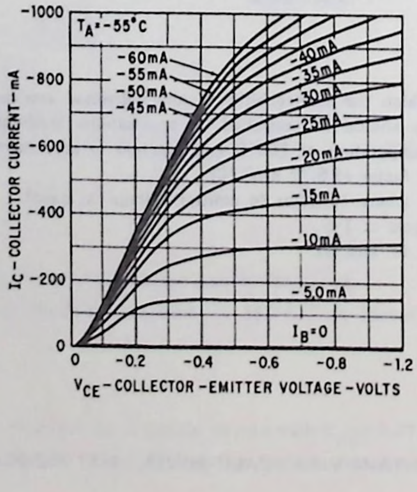
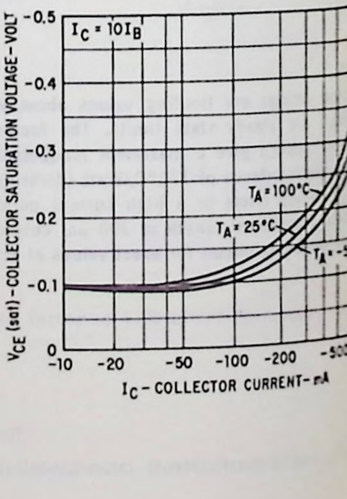


COLLECTOR CHARACTERISTICS



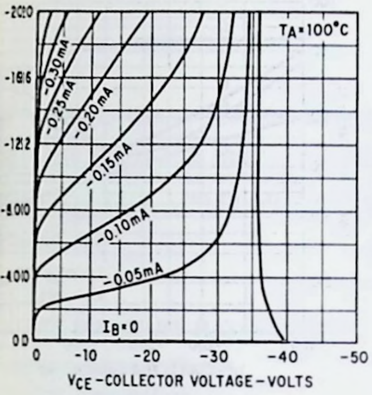
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

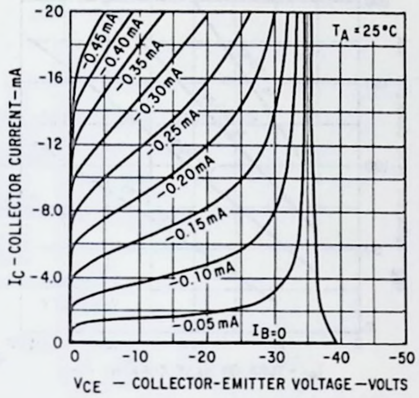


FAIRCHILD TRANSISTORS 2N5022 • 2N5023

TYPICAL ELECTRICAL CHARACTERISTICS

2N5023


COLLECTOR CHARACTERISTICS*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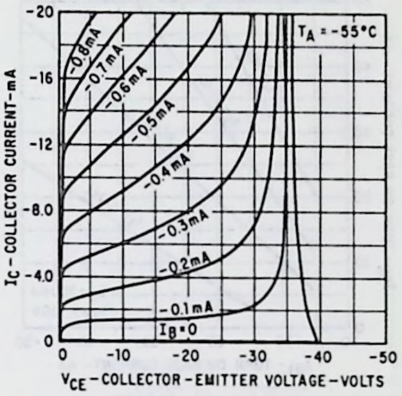
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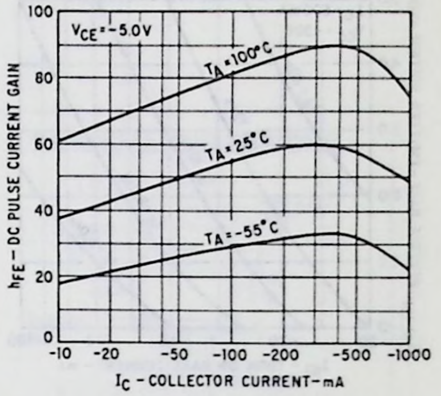
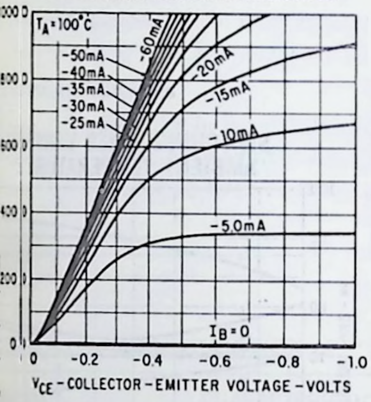

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT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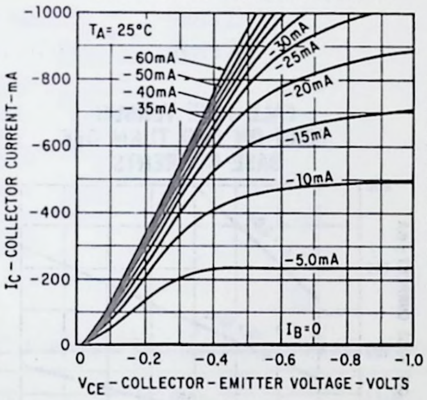
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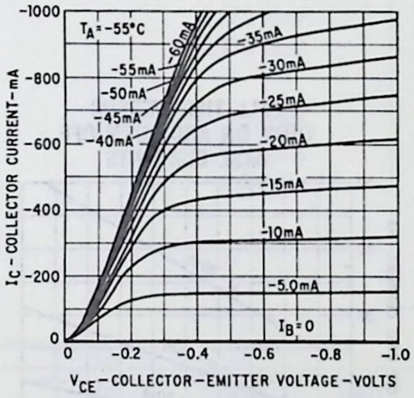
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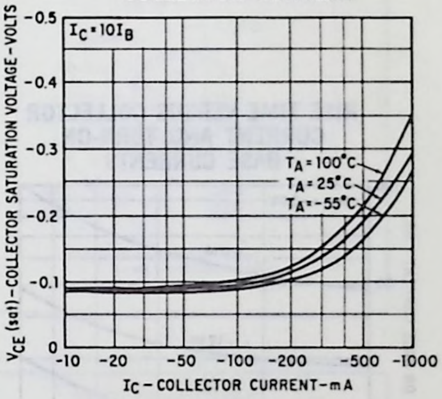
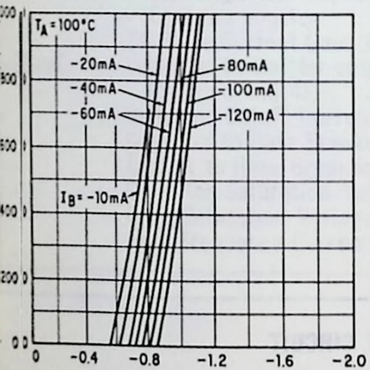
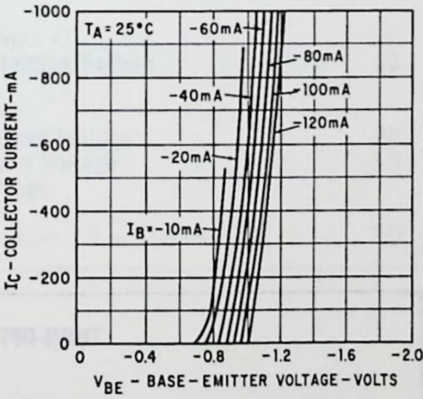

COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

2N5022 • 2N5023


BASE CHARACTERISTIC*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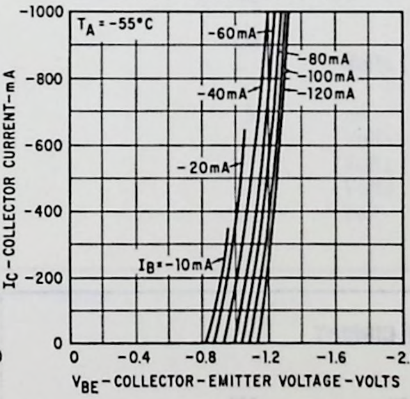
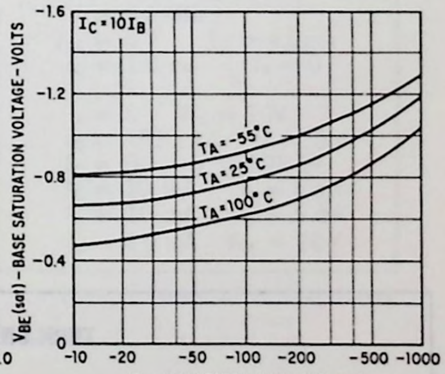
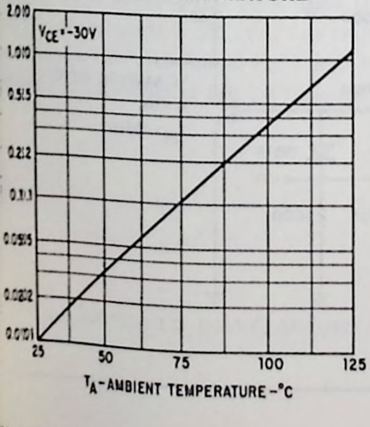
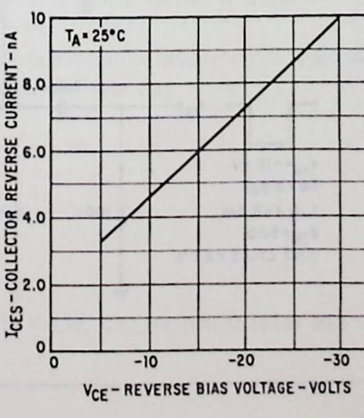
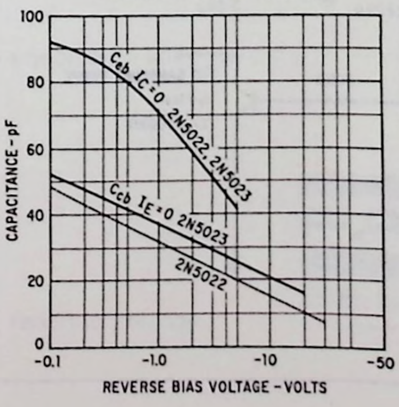
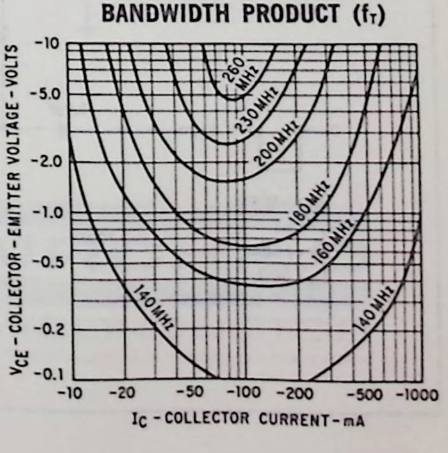

BASE CHARACTERISTIC*


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT


COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE


COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE


INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE


CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)

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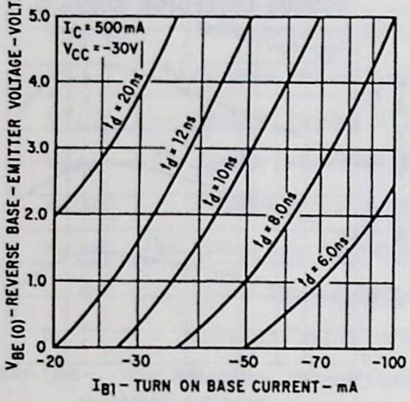
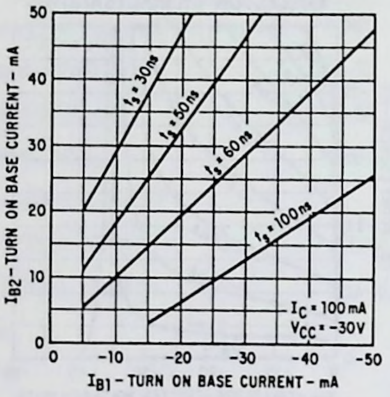
*Single family characteristic on Transistor Curve Tracer.

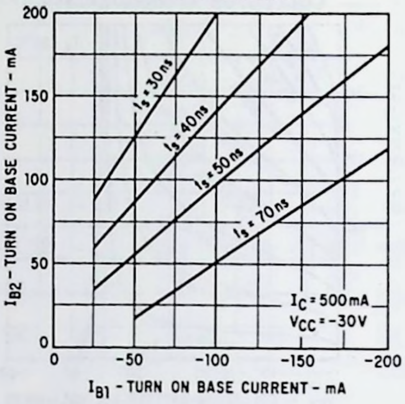
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



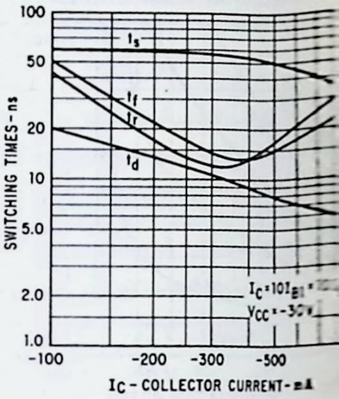
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



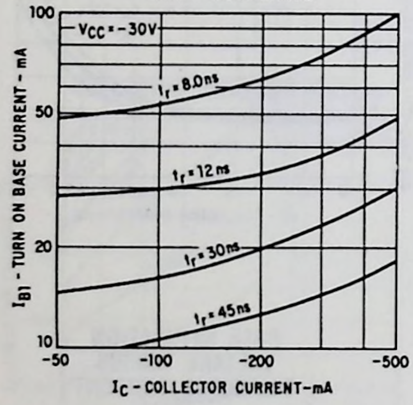
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



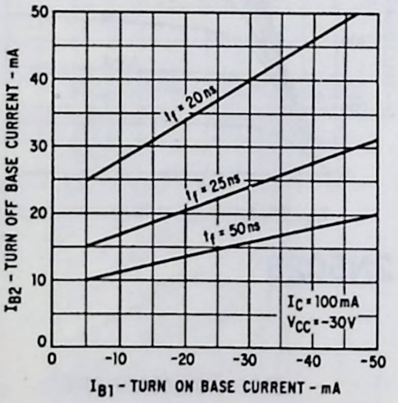
SWITCHING TIMES VERSUS COLLECTOR CURRENT



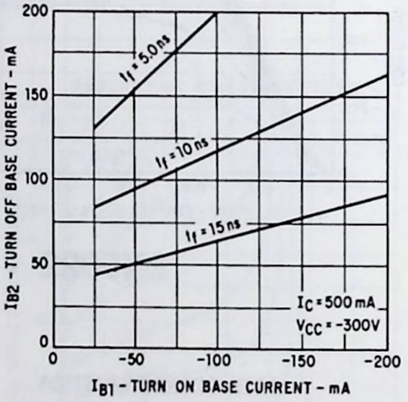
RISE TIME VERSUS COLLECTOR CURRENT AND TURN-ON BASE CURRENTS



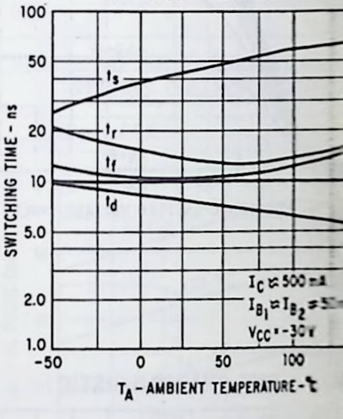
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



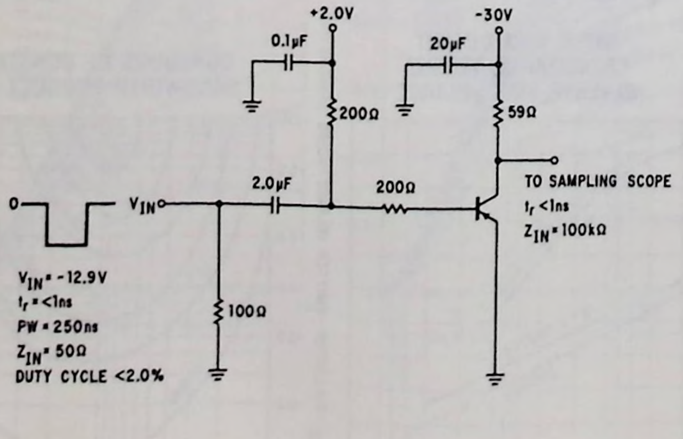
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

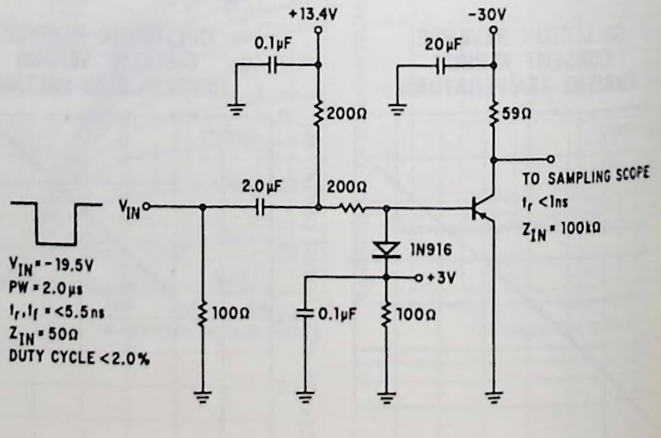


TURN-ON CIRCUIT


+2.0V
-30V
0.1μF
20μF
200Ω
59Ω
0
V_{IN}
2.0μF
200Ω
TO SAMPLING SCOPE
t_r <1ns
Z_{IN} = 100kΩ
100Ω

V_{IN} = -12.9V
t_r = <1ns
PW = 250ns
Z_{IN} = 50Ω
DUTY CYCLE <2.0%

TURN-OFF CIRCUIT


+13.4V
-30V
0.1μF
20μF
200Ω
59Ω
V_{IN}
2.0μF
200Ω
TO SAMPLING SCOPE
t_r <1ns
Z_{IN} = 100kΩ
1N916
+3V
100Ω
0.1μF
100Ω

V_{IN} = -19.5V
PW = 2.0μs
t_r, t_f = <5.5ns
Z_{IN} = 50Ω
DUTY CYCLE <2.0%

SE5050 • SE5051

NPN RF AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

LOW FEEDBACK (Cre) -- 0.25–0.50 pF (Guaranteed Min. and Max.)

LOW NOISE FIGURE -- 4 dB (Max.) at 100 MHz

HIGH POWER GAIN -- 20 dB (Min.) at 100 MHz

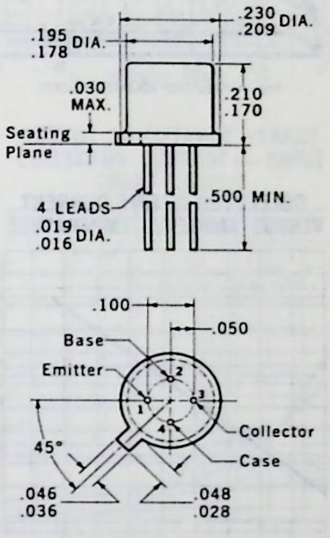
FORWARD AGC

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature		−55°C to +175°C
Operating Junction Temperature		175°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature	(Note 2)	0.260 Watt
at 25°C Ambient Temperature	(Note 2)	0.175 Watt
Maximum Voltages		
V_{CBO} Collector to Base Voltage		20 Volts
V_{CEO} Collector to Emitter Voltage	(Note 3)	20 Volts
V_{EBO} Emitter to Base Voltage		3.0 Volts

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 0.47 gram

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	**Noise Figure (f = 100 MHz)** **SE5050** (Notes 5 and 6)		**3.0**	**4.0**	**dB**	$V_{AGC} = 2.0\,V$ $R_G = 75\Omega$
NF	**Noise Figure (f = 100 MHz)** **SE5051** (Notes 5 and 6)		3.0		dB	$V_{AGC} = 2.0\,V$ $R_G = 75\Omega$
PG	**Power Gain (f = 100 MHz)** (Notes 5 and 6)	**20**	**27.5**		**dB**	$V_{AGC} = 2.0\,V$ $R_G = 75\Omega$
$V_{AGC(30)}$	AGC Voltage for 30 db gain reduction (f = 100 MHz)		4.7		Volts	$R_S = 75\Omega$ (Notes 5 and 6)
C_{re}	**Reverse transfer capacity** Common emitter	**0.25**	**0.37**	**0.50**	**pF**	$I_E = 0$ $V_{CB} = 10\,V$ $f = 1.0\,MHz$
h_{FE}	DC Pulse Current Gain (Note 4)	20	40	200		$V_{CE} = 5\,V$ $I_C = 4.0\,mA$
V_{CEO} (sust)	**Collector to Emitter sustaining Voltage** (Notes 3 and 4)	**20**			**Volts**	$I_C = 1.0\,mA$ $I_B = 0$
I_{CBO}	Collector Cutoff Current			50	nA	$I_E = 0$ $V_{CB} = 10V$
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	$I_C = 100\,\mu A$ $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	$I_C = 0$ $I_E = 100\,\mu A$
V_{CE} (sat)	Collector Saturation Voltage			3.0	Volts	$I_C = 10\,mA$ $I_B = 5\,mA$
V_{BE} (sat)	Base Saturation Voltage			0.96	Volt	$I_C = 10\,mA$ $I_B = 5\,mA$
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0				$I_C = 4.0\,mA$ $V_{CE} = 10\,V$

* Planar is a patented Fairchild process.

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 583°C/Watt (derating factor of 1.73 mW/°C); junction-to-ambient thermal resistance of 850°C/Watt (derating factor of 1.17 mW/°C).

Rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μsec; duty cycle = 1%.

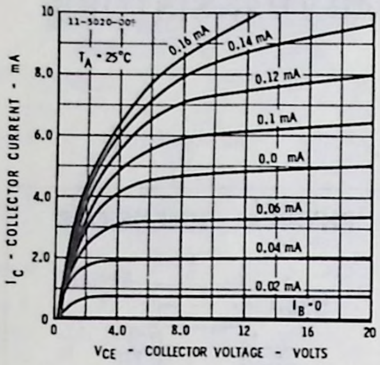
Test conditions are as shown on Fig. 1 with fixed neutralization. Neutralization is optimum for a typical device with $C_{re} \cong 0.37$ pF.

50Ω input is transformed so that the transistor under test sees 75Ω.

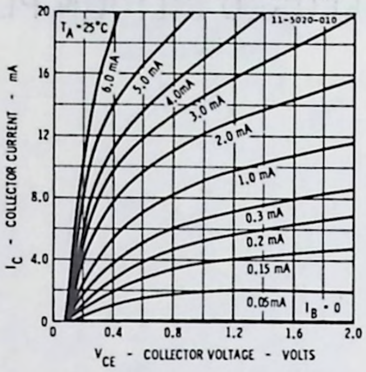
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

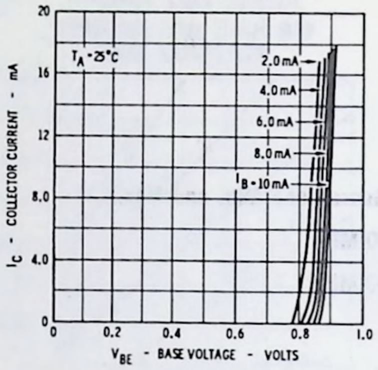
COLLECTOR CHARACTERISTICS



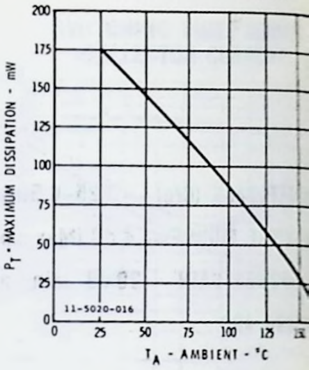
COLLECTOR CHARACTERISTICS



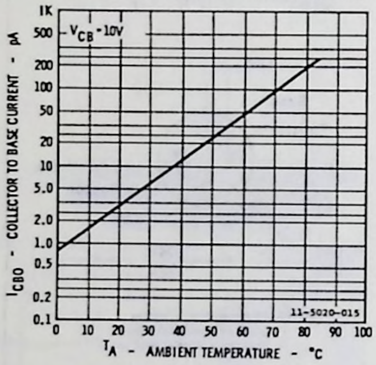
BASE CHARACTERISTICS



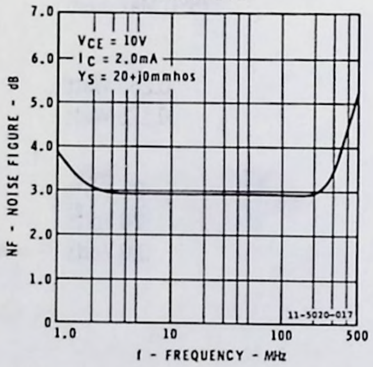
MAXIMUM DISSIPATION VERSUS TEMPERATURE



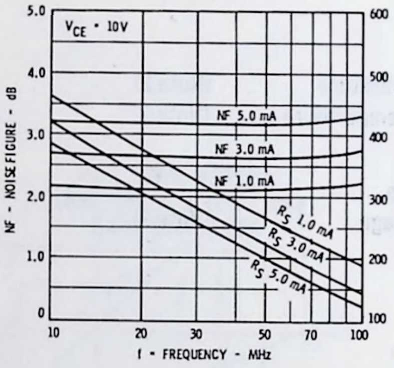
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



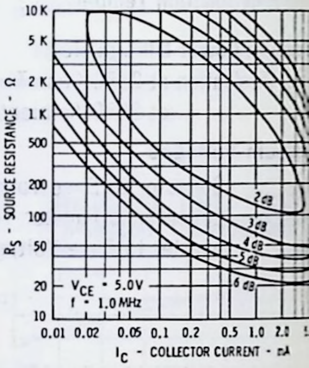
NOISE FIGURE VERSUS FREQUENCY



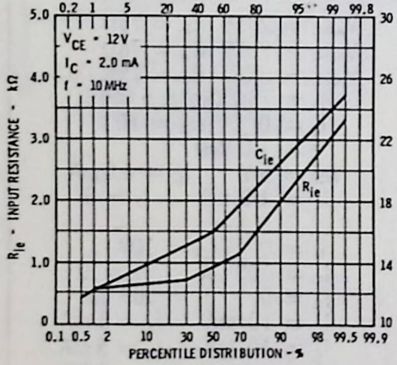
SOURCE RESISTANCE AND NOISE FIGURE VERSUS FREQUENCY AT VARIOUS VALUES OF COLLECTOR CURRENT



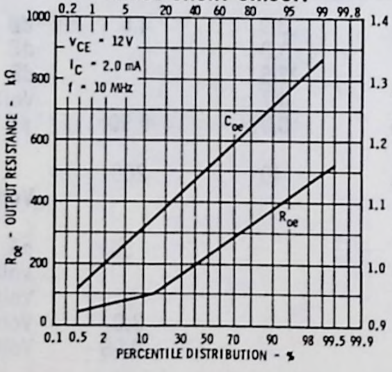
CONTOURS OF CONSTANT N FIGURE AT 1 MHz



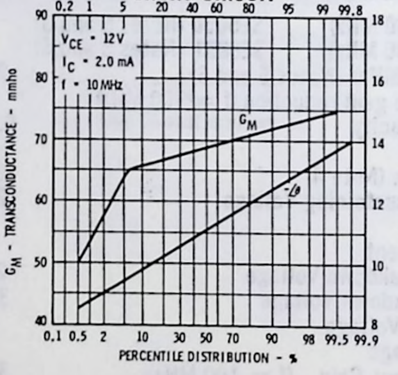
DISTRIBUTION OF COMMON EMITTER INPUT RESISTANCE AND INPUT CAPACITANCE — OUTPUT SHORT CIRCUIT



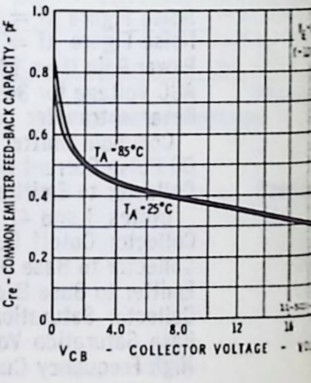
DISTRIBUTION OF COMMON EMITTER OUTPUT RESISTANCE AND OUTPUT CAPACITANCE — INPUT SHORT CIRCUIT



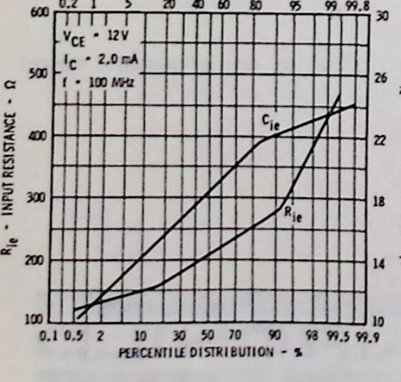
DISTRIBUTION OF PHASE ANGLE AND TRANSCONDUCTANCE — COMMON EMITTER CONFIGURATION — OUTPUT SHORT CIRCUIT



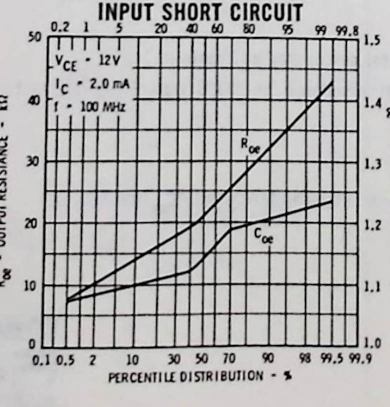
COMMON EMITTER FEED-BACK CAPACITY VERSUS COLLECTOR VOLTAGE



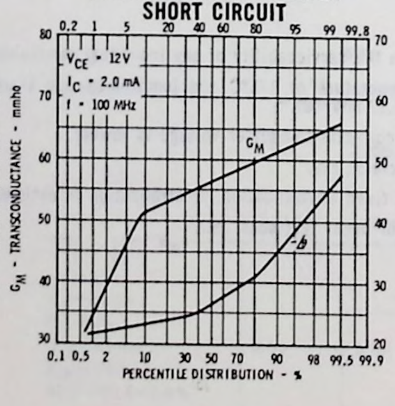
DISTRIBUTION OF COMMON EMITTER INPUT RESISTANCE AND INPUT CAPACITANCE — OUTPUT SHORT CIRCUIT



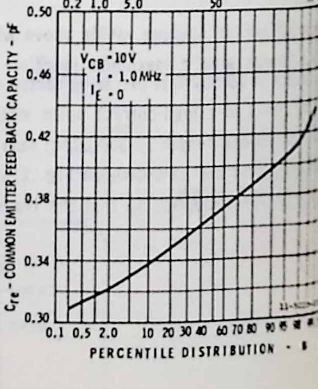
DISTRIBUTION OF COMMON EMITTER OUTPUT RESISTANCE AND OUTPUT CAPACITANCE — INPUT SHORT CIRCUIT



DISTRIBUTION OF PHASE ANGLE AND TRANSCONDUCTANCE — COMMON EMITTER CONFIGURATION — OUTPUT SHORT CIRCUIT

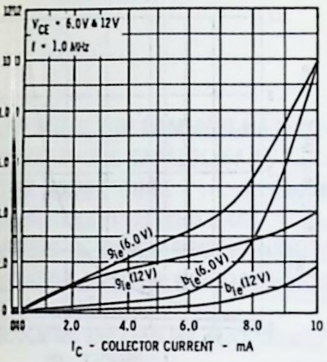


DISTRIBUTION OF COMMON EMITTER FEED-BACK CAPACITY

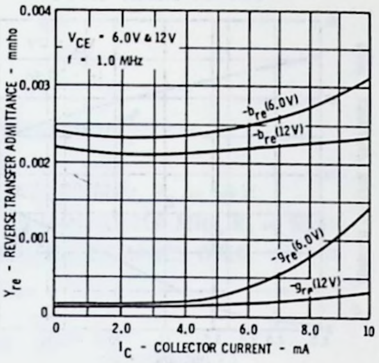


TYPICAL SMALL SIGNAL "Y" PARAMETERS - COMMON EMITTER

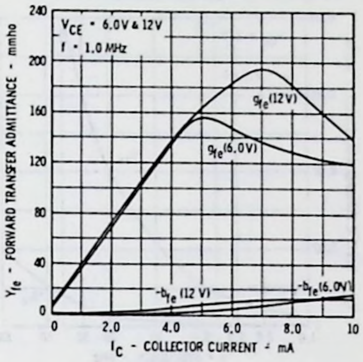
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



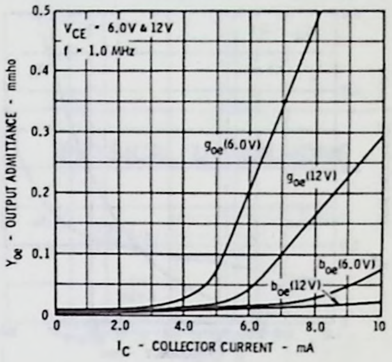
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



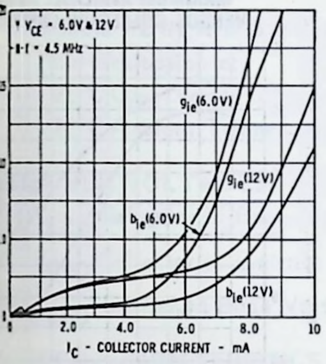
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



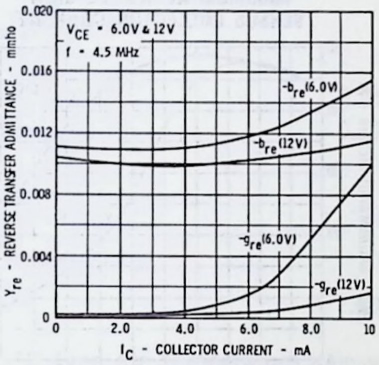
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



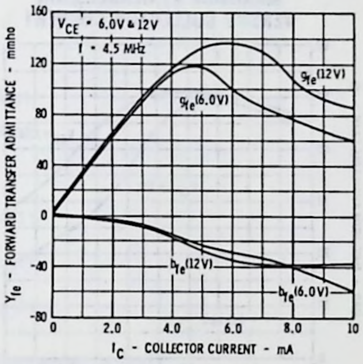
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



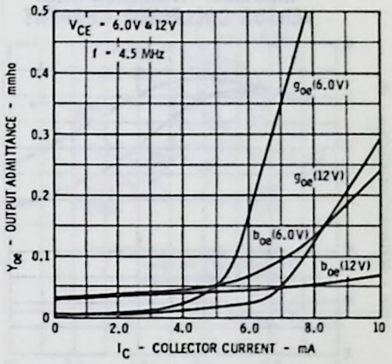
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



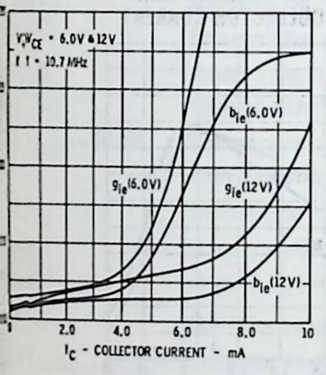
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



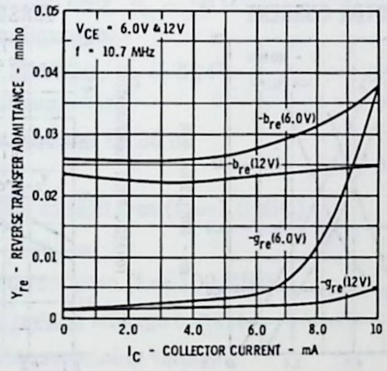
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



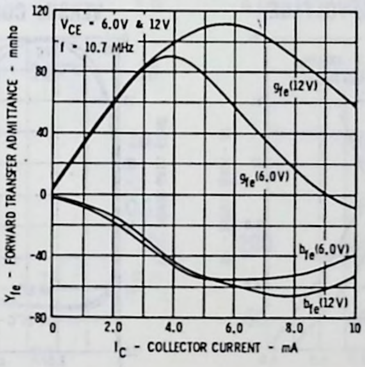
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



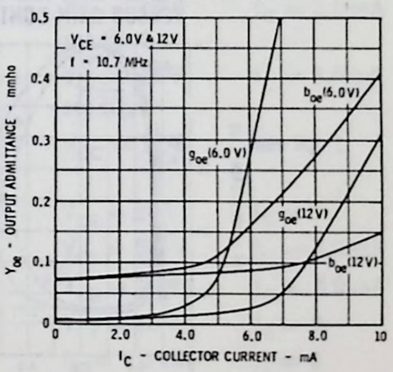
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



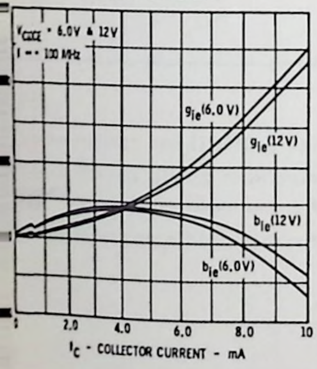
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



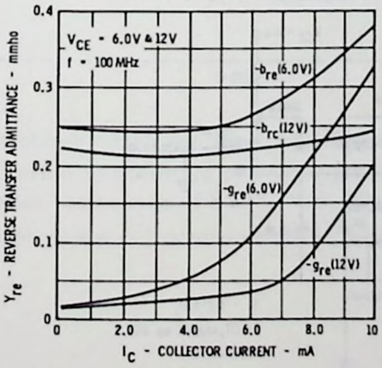
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



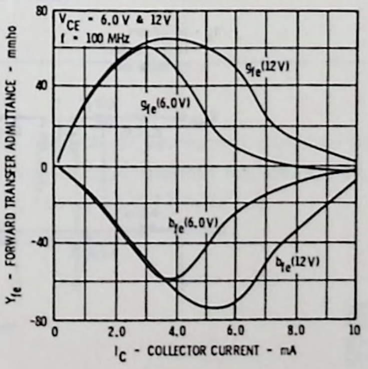
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



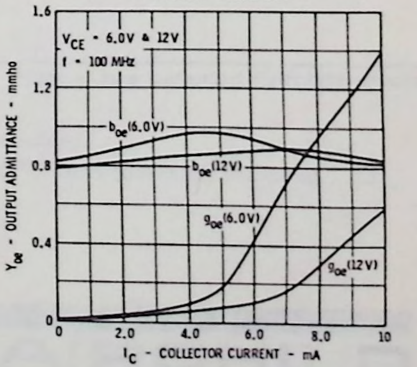
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT

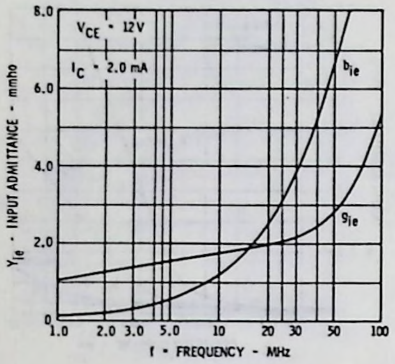


OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT

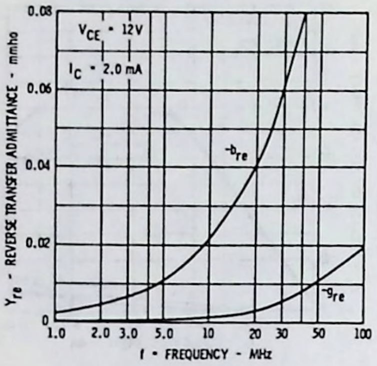


TYPICAL ELECTRICAL CHARACTERISTICS

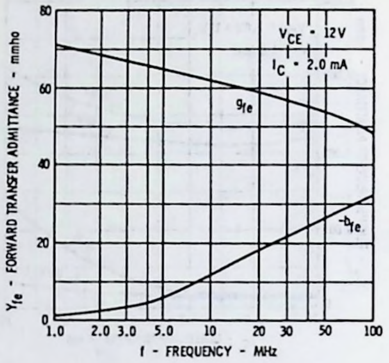
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



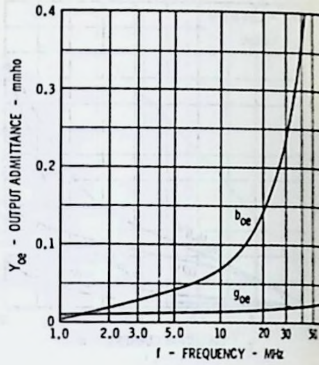
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



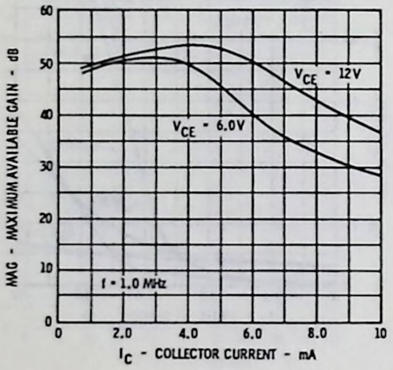
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



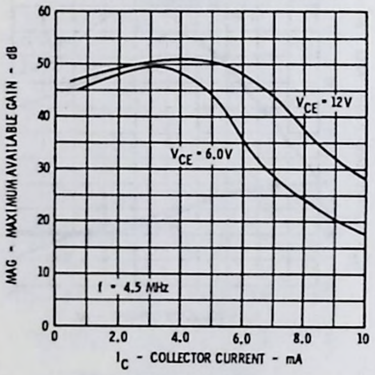
OUTPUT ADMITTANCE VERSU FREQUENCY — INPUT SHORT CIRCUIT



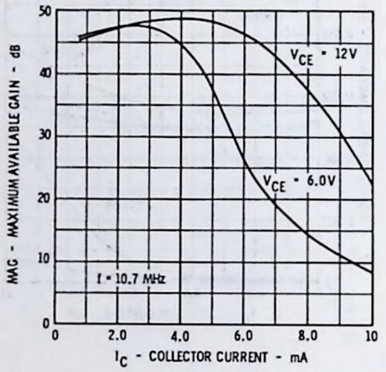
MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



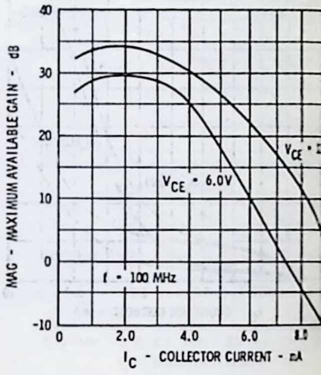
MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



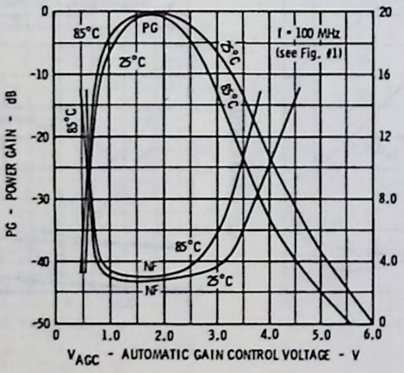
MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



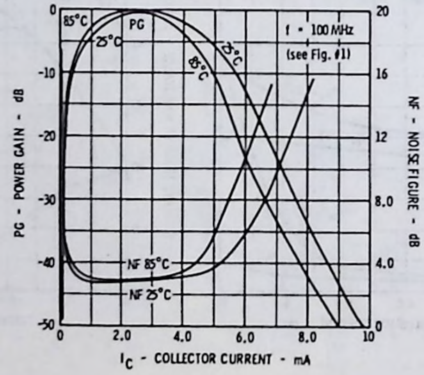
MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURREN



POWER GAIN AND NOISE FIGURE VERSUS GAIN CONTROL VOLTAGE



POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT

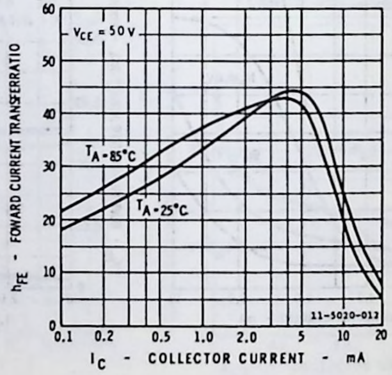
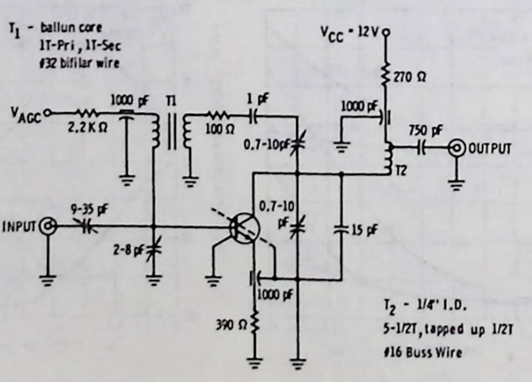


FIG. 1–100 MHz AGC, POWER GAIN, AND NOISE FIGURE TEST JIG


T_1 - ballun core
1T-Pri, 1T-Sec
#32 bifilar wire
V_{CC} = 12V
270 Ω
V_{AGC}
2.2 KΩ
1000 pF
T1
100 Ω
1 pF
1000 pF
0.7-10pF
750 pF
OUTPUT
T2
INPUT
9-35 pF
2-8 pF
0.7-10 pF
15 pF
1000 pF
390 Ω
T_2 - 1/4" I.D.
5-1/2T, tapped up 1/2T
#16 Buss Wire

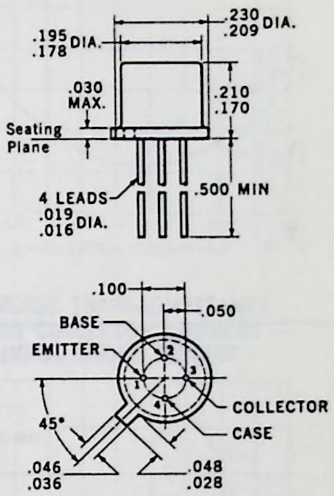
SE5052

NPN RF—AGC AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **OPTIMIZED FOR COMMON-BASE VHF OPERATION**
- **FORWARD AGC CAPABILITY TO —30 dB**
- **LOW NOISE FIGURE . . . 4.0 dB MAX. AT 200 MHz, $R_S = 50\ \Omega$**
- **HIGH UNNEUTRALIZED GAIN . . . 16 dB MIN. AT 200 MHz, $R_S = 50\ \Omega$**
- **OFFERS IMPROVED CROSS-MODULATION PERFORMANCE OVER COMMON EMITTER CONFIGURATION**

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package weight is 0.47 gram

SOLUTE MAXIMUM RATINGS (Note 1)

MAXIMUM TEMPERATURES

Storage Temperature	−55°C to +175°C
Operating Junction Temperature	+175°C

MAXIMUM POWER DISSIPATION

Total dissipation at	
25°C Case Temperature (Note 2)	0.260 Watt
25°C Ambient Temperature (Note 2)	0.175 Watt

MAXIMUM VOLTAGES

V_{CBO}	Collector to Base Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	20 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
N.F.	**Noise figure, f = 200 MHz, $R_S = 50\ \Omega$ Common base configuration**		**3.0**	**4.0**	**dB**	**$V_{CC} = 10$ V see fig. 1**	**$I_C = 3.0$ mA**
P.G.	**Power gain, f = 200 MHz, $R_S = 50\ \Omega$ Unneutralized common-base**	**16**	**18**		**dB**	**$V_{CC} = 10$ V see fig. 1**	**$I_C = 3.0$ mA**
I_{AGC} —30 dB	**Collector current required for 30 dB gain reduction**		**10.0**		**mA**	**$V_{CC} = 10$ V**	**see fig. 1**
C_{ce}	Collector to emitter capacitance (f = 1.0 MHz)		0.17		pF	$V_{CE} = 10$ V	$I_B = 0$
I_B	Base current		80	200	µA	$V_{CB} = 5.0$ V	$I_C = 4.0$ mA
h_{fe}	High frequency current gain (f = 100 MHz)	3.75	5.0			$V_{CE} = 10$ V	$I_C = 4.0$ mA
I_{CBO}	Collector to base reverse leakage current			50	nA	$V_{CB} = 10$ V	$I_E = 0$
$V_{CEO(sus)}$	Collector to emitter sustaining voltage	20			V	$I_C = 1.0$ mA	$I_B = 0$
BV_{CBO}	Collector to base breakdown voltage	20			V	$I_C = 100\ \mu$A	$I_E = 0$
BV_{EBO}	Emitter to base breakdown voltage	3.0			V	$I_C = 0$	$I_E = 100\ \mu$A
$V_{CE(sat)}$	Collector to emitter saturation voltage			3.0	V	$I_C = 10$ mA	$I_B = 5.0$ mA

***Planar is a patented Fairchild process.**

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.

These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 583°C/Watt (derating factor of 1.73 mW/°C); junction-to-ambient thermal resistance of 850°C/Watt (derating factor of 1.17 mW/°C).

Rating refers to a high-current point where collector-to-emitter voltage is lowest.

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

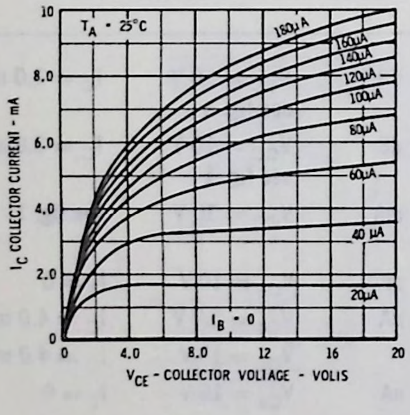
FAIRCHILD TRANSISTOR SE5052

TYPICAL COMMON-BASE "Y" PARAMETERS - $T_A = 25°C$
$V_{CB} = 10$ V, $I_C = 3.0$ mA, f = 200 MHz

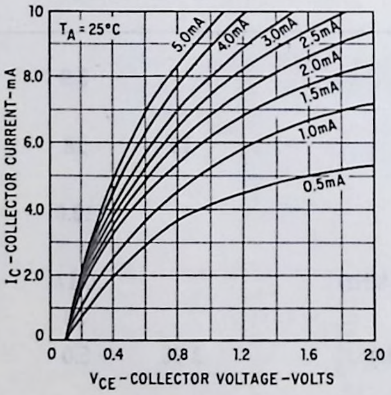
SYMBOL	PARAMETER	MAGNITUDE
$\lvert Y_{ib} \rvert$	INPUT ADMITTANCE OUTPUT SHORT CIRCUIT	50 − j40 mmhos
$\lvert Y_{rb} \rvert$	REVERSE TRANSADMITTANCE INPUT SHORT CIRCUIT	210 μmhos at ∠ −95°
$\lvert Y_{fb} \rvert$	FORWARD TRANSADMITTANCE OUTPUT SHORT CIRCUIT	70 mmhos at ∠ 120°
$\lvert Y_{ob} \rvert$	OUTPUT ADMITTANCE INPUT SHORT CIRCUIT	0.2 + j1.45 mmhos

TYPICAL ELECTRICAL CHARACTERISTICS

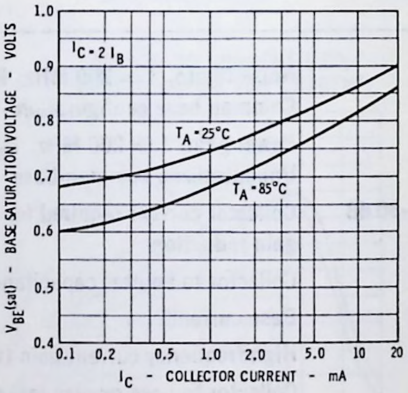
COLLECTOR CHARACTERISTICS*



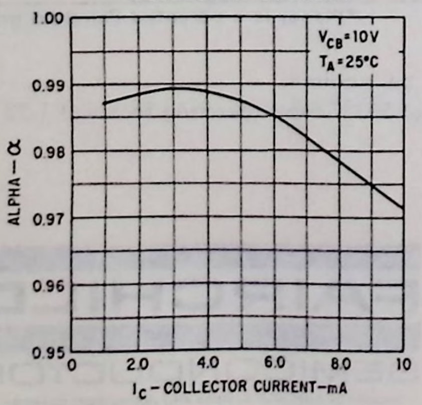
COLLECTOR CHARACTERISTICS*



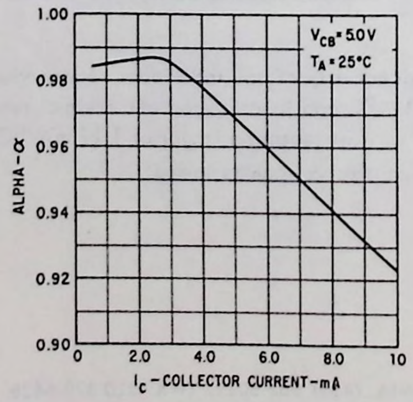
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



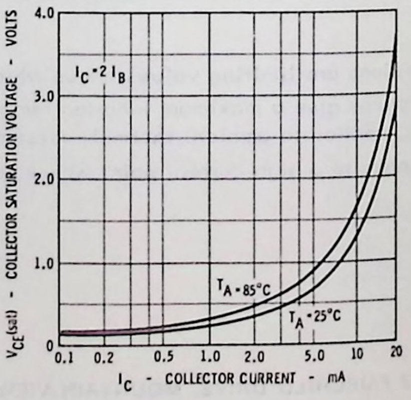
ALPHA VERSUS COLLECTOR CURRENT



ALPHA VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

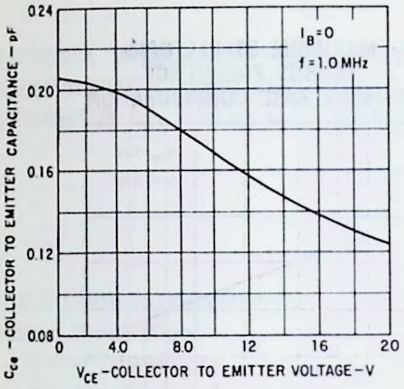


* Single family characteristic on Transistor Curve Tracer

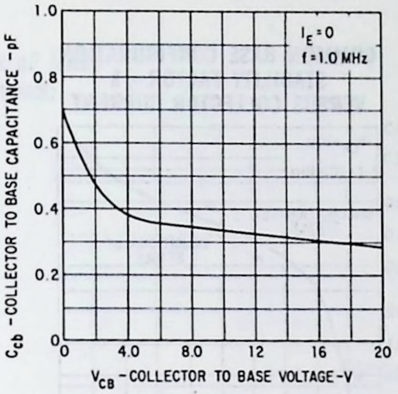
FAIRCHILD TRANSISTOR SE5052

TYPICAL ELECTRICAL CHARACTERISTICS

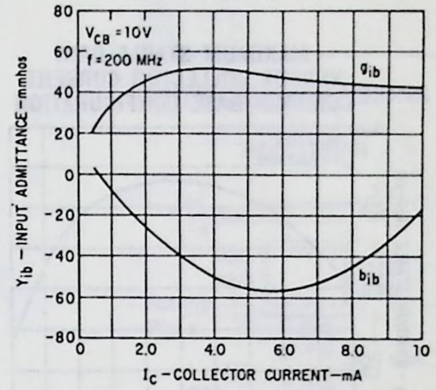
COLLECTOR TO EMITTER CAPACITANCE VERSUS COLLECTOR TO EMITTER VOLTAGE



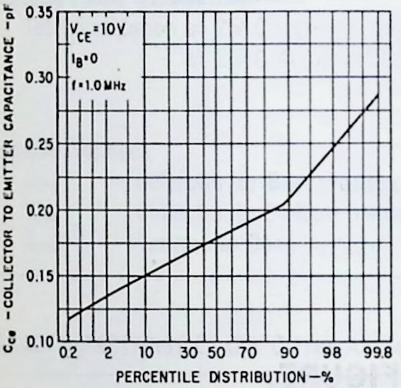
COLLECTOR TO BASE CAPACITANCE VERSUS COLLECTOR TO BASE VOLTAGE



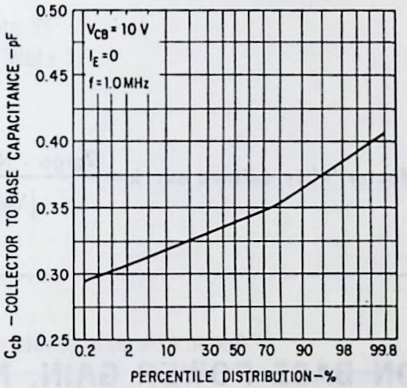
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



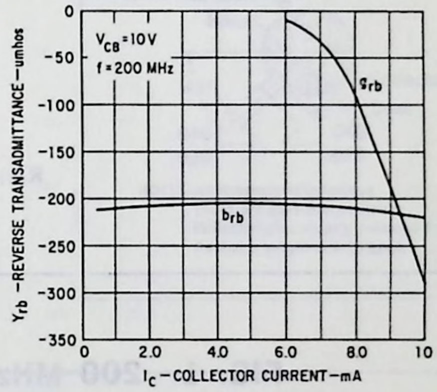
DISTRIBUTION OF COLLECTOR* TO EMITTER CAPACITANCE



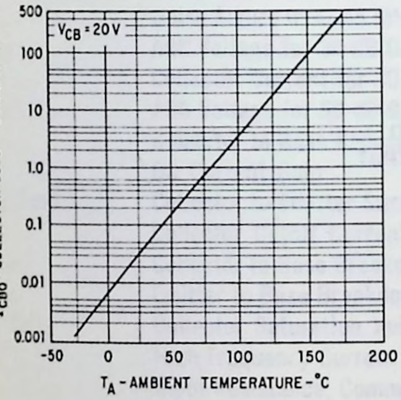
DISTRIBUTION OF COLLECTOR* TO BASE CAPACITANCE



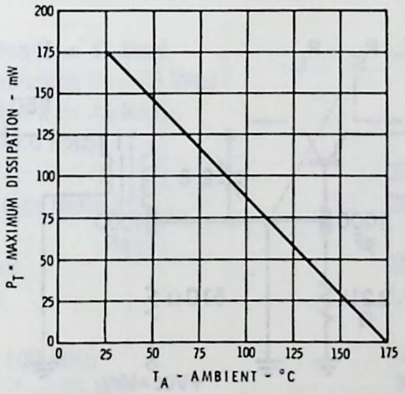
REVERSE TRANSADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



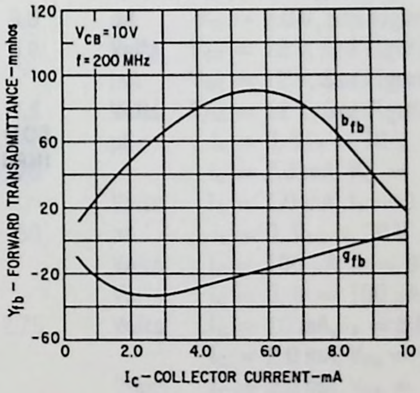
COLLECTOR CUT OFF CURRENT VERSUS AMBIENT TEMPERATURE



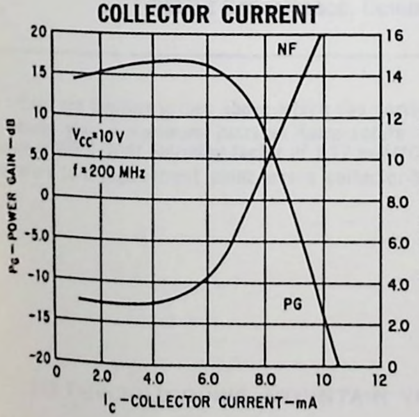
MAXIMUM DISSIPATION VERSUS TEMPERATURE



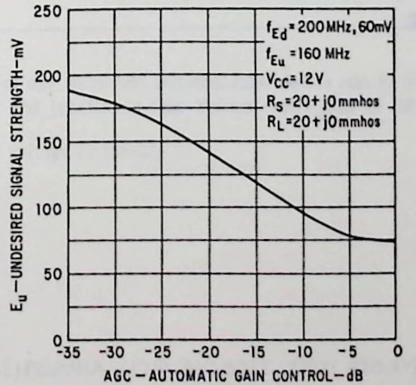
FORWARD TRANSADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



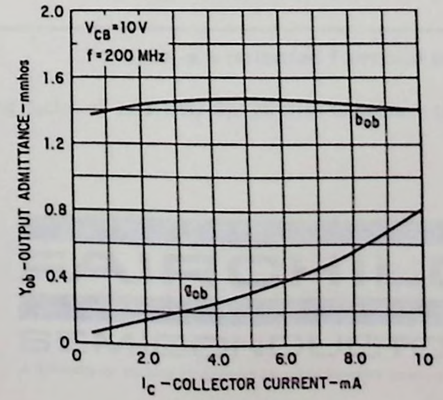
POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



UNDESIRED SIGNAL STRENGTH FOR 1.0% CROSS MODULATION VERSUS AUTOMATIC GAIN CONTROL (FORWARD)



OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



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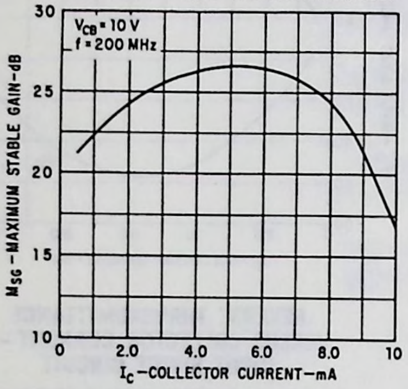
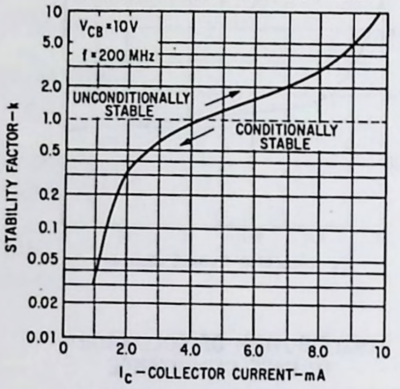
* These distributions derived from a random sample of 200 units.

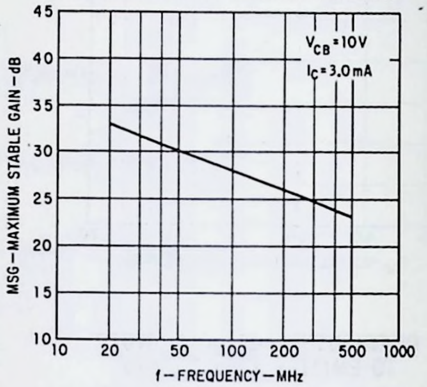
MAXIMUM STABLE GAIN VERSUS COLLECTOR CURRENT COMMON BASE CONFIGURATION



COMMON BASE CONFIGURATION STABILITY FACTOR - k VERSUS COLLECTOR CURRENT

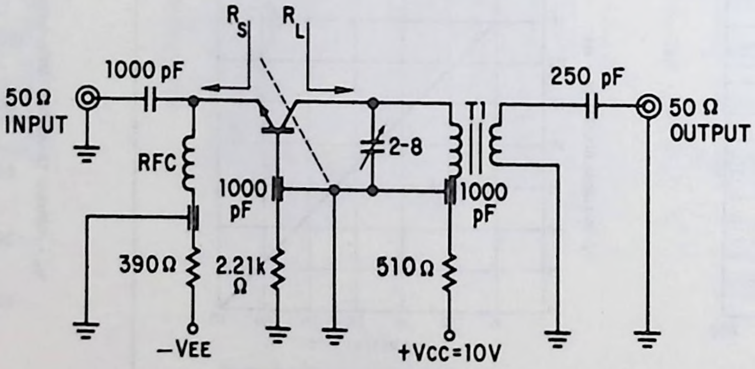


MAXIMUM STABLE GAIN VERSUS FREQUENCY COMMON BASE CONFIGURATION



Rollett stability factor 'k' is defined as: $k = \dfrac{2g_ig_o - Re(Y_fY_r)}{|Y_fY_r|}$

FIG. 1 200 MHz COMMON BASE POWER GAIN, NOISE FIGURE, AUTOMATIC GAIN CONTROL TEST CIRCUIT


R_S
R_L
1000 pF
50 Ω INPUT
RFC
1000 pF
390 Ω
2.21k Ω
–VEE
2-8
T1
1000 pF
510 Ω
+VCC=10V
250 pF
50 Ω OUTPUT

T1—3:1 RATIO NO. 22 BIFILAR ON MICROMETALS TOROID, P/N T30-12

$R_S = 50\ \Omega$, $R_L = 2.5\ k\Omega$

f_{bw} - 8.0 MHz

SE5055

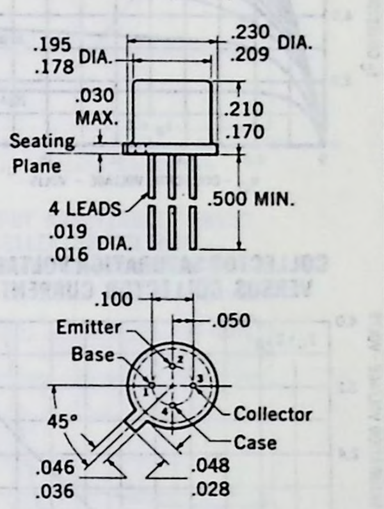
NPN RF-AGC AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

LOW FEEDBACK CAPACITY (C_{cb}) —0.13 pF TYPICAL, 0.22 pF MAX.
HIGH UNNEUTRALIZED POWER GAIN —27 dB MIN. at 45 MHz.
V_{AGC} GUARANTEED FOR —30 dB and —50 dB at 45 MHz.

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-72)



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Collector electrically isolated from case
Package weight is 0.36 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +175°C
Operating Junction Temperature	+175°C

Maximum Power Dissipation

Total dissipation at 25°C Case Temperature [Note 2]	0.260 Watt
at 25°C Ambient Temperature [Note 2]	0.175 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage [Note 3]	20 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
P.G.	**Power Gain (f = 45 MHz)**	**27**	**29**		**dB**	**$V_{BE} = 2.0$ V, See Figure 1**
N.F.	Noise Figure (f = 45 MHz)		2.7	5.0	dB	$V_{BE} = 2.0$ V, See Figure 1
V_{AGC}	**AGC Voltage for 30 dB Gain Reduction (f = 45 MHz)**	**3.3**	**4.15**	**5.0**	**Volts**	**$V_{CC} = 12$ V, See Figure 1**
I_{AGC}	Collector Current for 30 dB Gain Reduction (f = 45 MHz)		7.2		mA	$V_{CC} = 12$ V, See Figure 1
V_{AGC}	**AGC Voltage for 50 dB Gain Reduction (f = 45 MHz)**		**6.15**	**7.5**	**Volts**	**$V_{CC} = 12$ V, See Figure 1**
C_{cb}	**Collector to Base Capacitance (f = 1.0 MHz)**		**0.13**	**0.22**	**pF**	**$I_E = 0$, $V_{CB} = 10$ V**
h_{FE}	DC Current Gain	20	80	220		$I_C = 2.0$ mA, $V_{CE} = 10$ V
V_{CEO} (Sust)	Collector to Emitter Sustaining Voltage [Note 3]	20			Volts	$I_C = 1.0$ mA, $I_B = 0$
I_{CBO}	Collector Cutoff Current			50	nA	$I_E = 0$, $V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	$I_C = 100\ \mu A$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	$I_C = 0$, $I_E = 100\ \mu A$
V_{CE} (Sat)	Collector Saturation Voltage			2.75	Volts	$I_C = 10$ mA, $I_B = 5.0$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	5.0			$I_C = 2.0$ mA, $V_{CE} = 10$ V
R_{iep}	Input Resistance, Common Emitter (f = 45 MHz)		400		Ohms	$I_C = 2.0$ mA, $V_{CE} = 10$ V
C_{iep}	Input Capacitance, Common Emitter (f = 45 MHz)		16		pF	$I_C = 2.0$ mA, $V_{CE} = 10$ V
R_{oep}	Output Resistance, Common Emitter (f = 45 MHz)		67		kohms	$I_C = 2.0$ mA, $V_{CE} = 10$ V
C_{oep}	Output Capacitance, Common Emitter (f = 45 MHz)		1.2		pF	$I_C = 2.0$ mA, $V_{CE} = 10$ V

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 583°C/Watt (derating factor of 1.73 mW/°C); junction-to-ambient thermal resistance of 850°C/Watt (derating factor of 1.17 mW/°C).

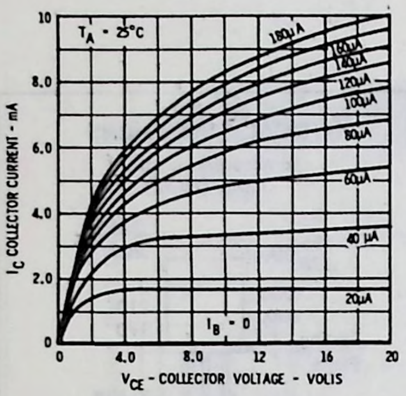
Rating refers to a high-current point where collector-to-emitter voltage is lowest.

* Planar is a patented Fairchild process.

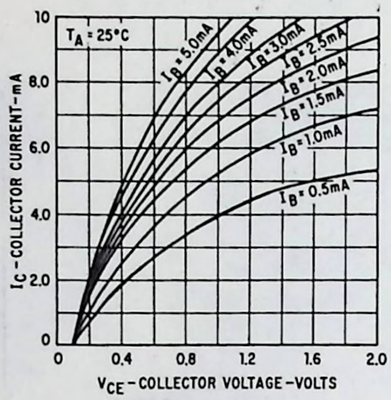
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

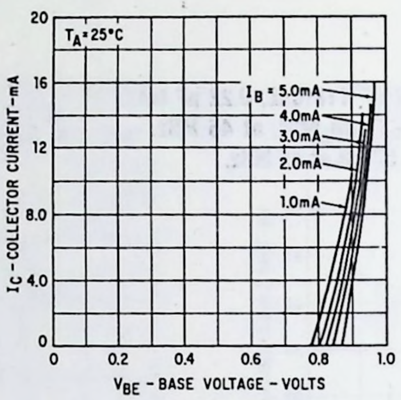
COLLECTOR CHARACTERISTICS*



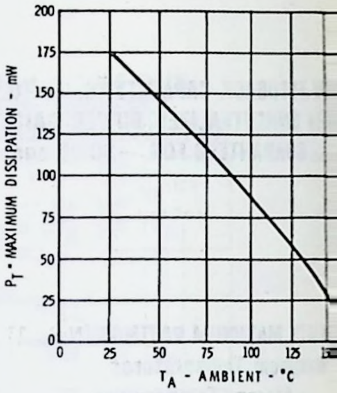
COLLECTOR CHARACTERISTICS*



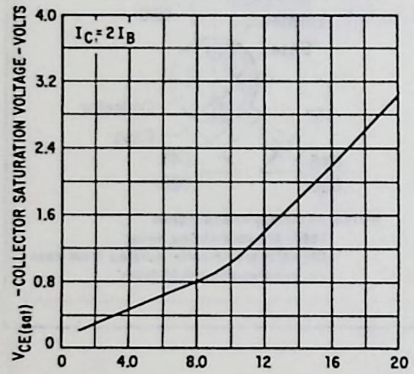
BASE CHARACTERISTICS*



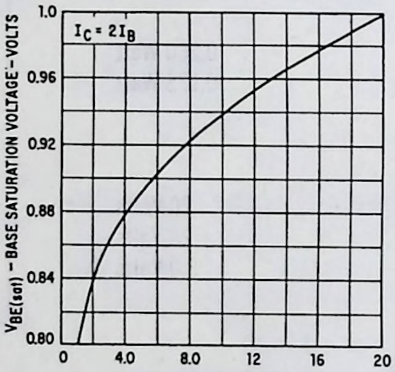
MAXIMUM DISSIPATION VERSUS TEMPERATURE



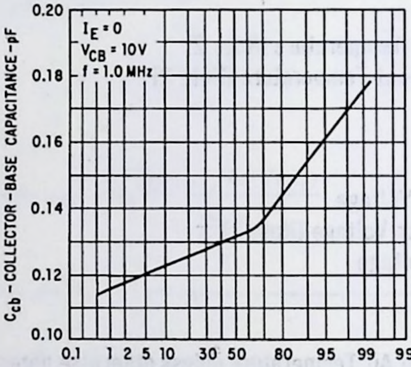
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



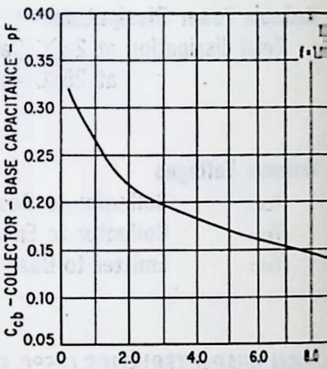
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



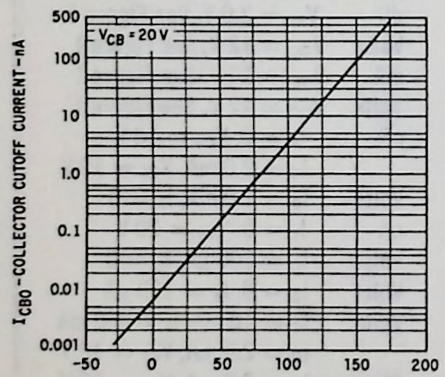
DISTRIBUTION OF COLLECTOR-BASE CAPACITANCE



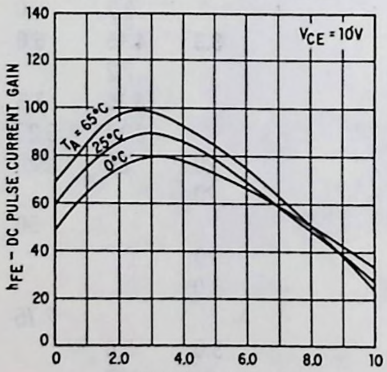
COLLECTOR-BASE CAPACITANCE VERSUS COLLECTOR-BASE VOLTAGE



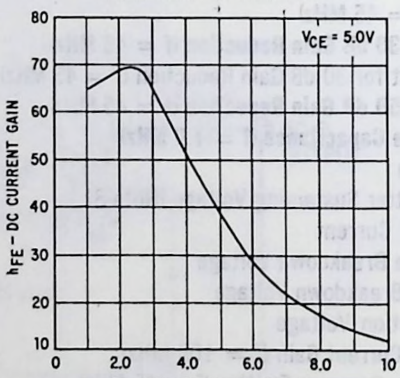
COLLECTOR CUT OFF CURRENT VERSUS AMBIENT TEMPERATURE



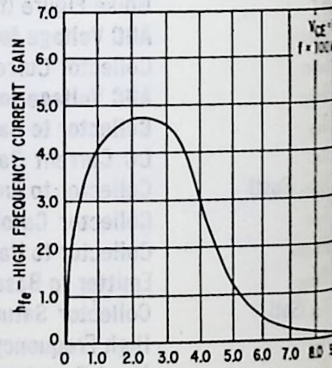
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



DC CURRENT GAIN VERSUS COLLECTOR CURRENT



HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT

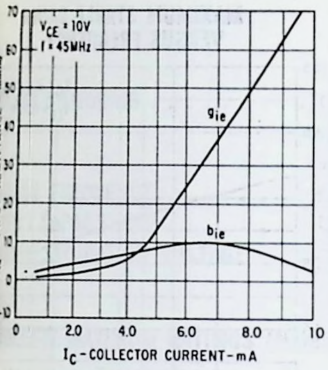


* Single family characteristic on Transistor Curve Tracer.

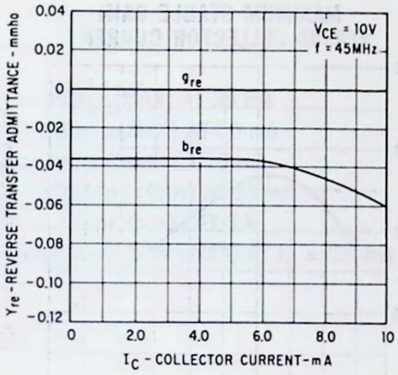
FAIRCHILD TRANSISTOR SE5055

TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

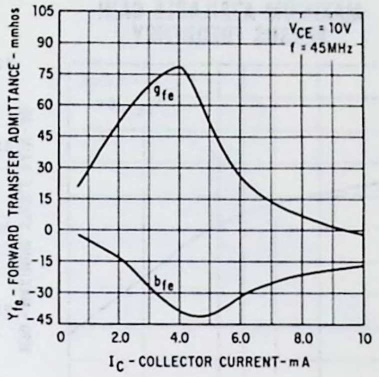
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



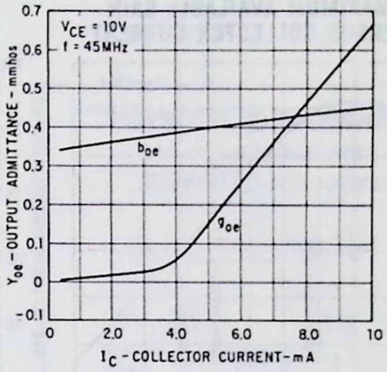
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



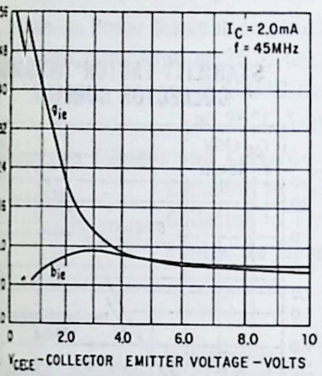
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHOT CIRCUIT



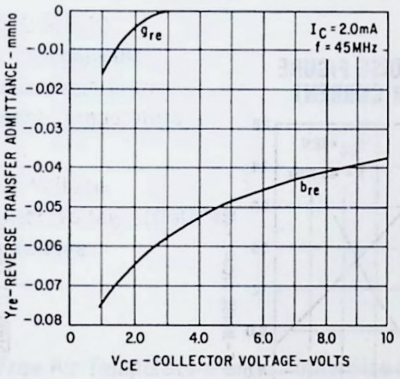
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



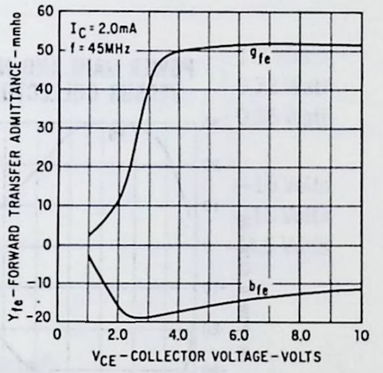
INPUT ADMITTANCE VERSUS COLLECTOR VOLTAGE — OUTPUT SHORT CIRCUIT



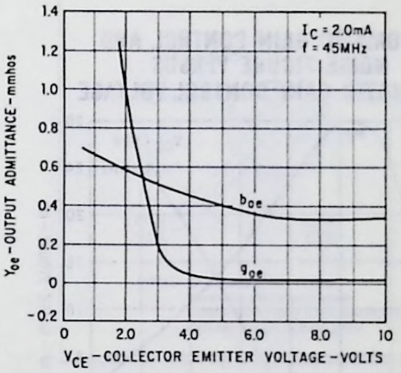
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR VOLTAGE — INPUT SHORT CIRCUIT



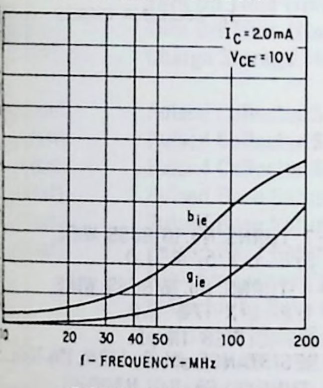
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR VOLTAGE — OUTPUT SHORT CIRCUIT



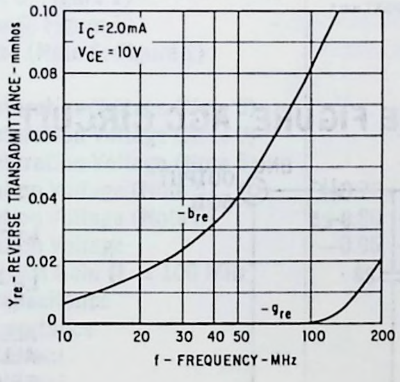
OUTPUT ADMITTANCE VERSUS COLLECTOR VOLTAGE — INPUT SHORT CIRCUIT



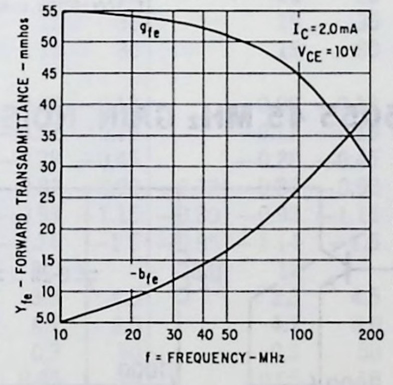
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



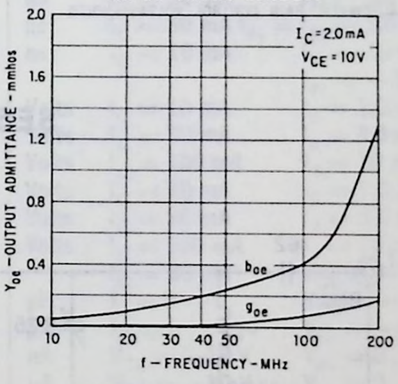
REVERSE TRANSADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



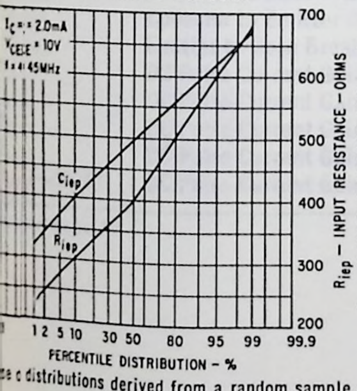
FORWARD TRANSADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



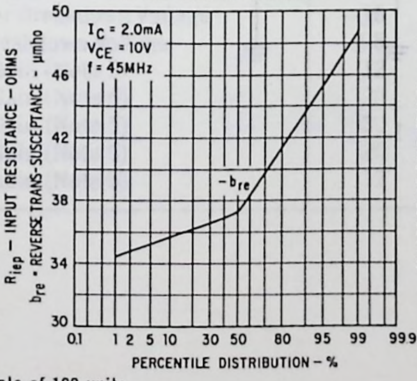
OUTPUT ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



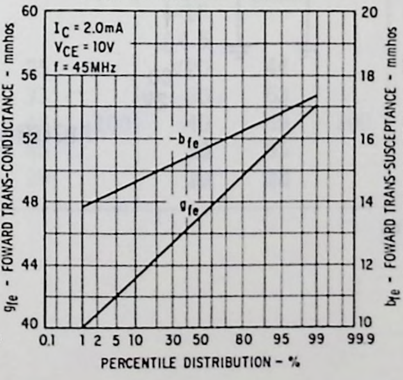
DISTRIBUTION OF INPUT CAPACITANCE AND INPUT RESISTANCE — OUTPUT SHORT CIRCUIT



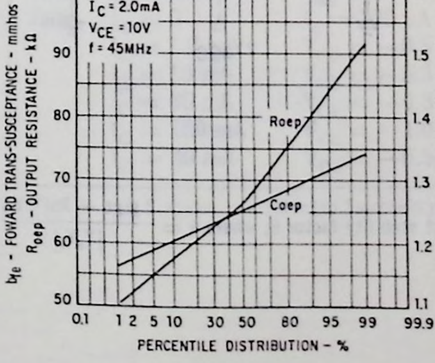
DISTRIBUTION OF REVERSE TRANSADMITTANCE — INPUT SHORT CIRCUIT



DISTRIBUTION OF FORWARD TRANSFER ADMITTANCE OUTPUT SHORT CIRCUIT

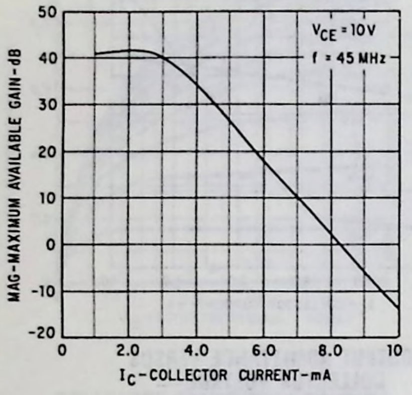


DISTRIBUTION OF OUTPUT CAPACITANCE AND OUTPUT RESISTANCE — INPUT SHORT CIRCUIT

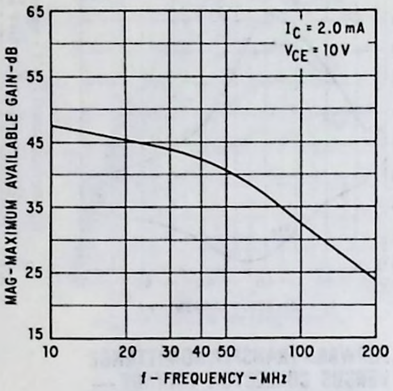


c distributions derived from a random sample of 100 units.

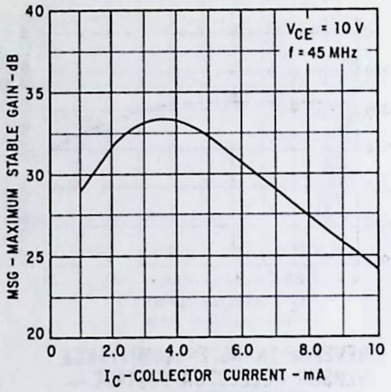
MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



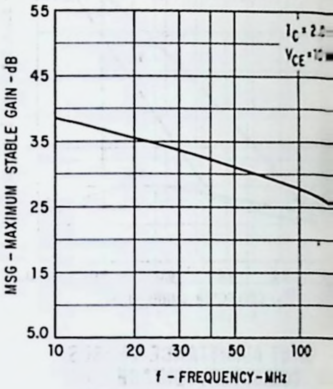
MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY



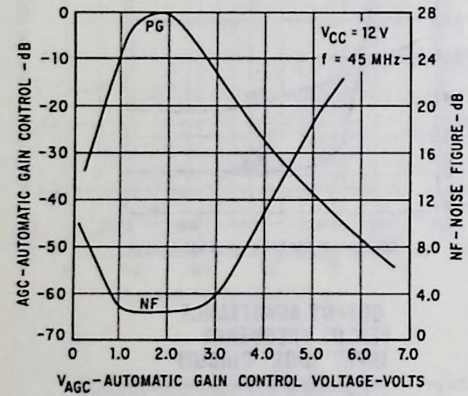
MAXIMUM STABLE GAIN VERSUS COLLECTOR CURRENT



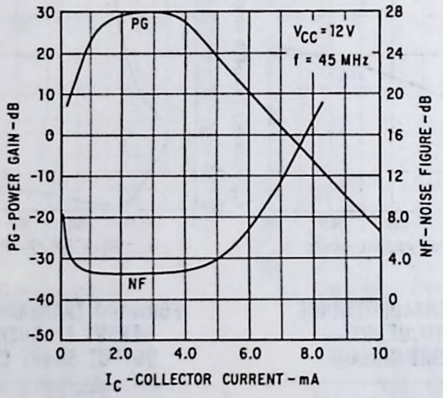
MAXIMUM STABLE GAIN VERSUS FREQUENCY



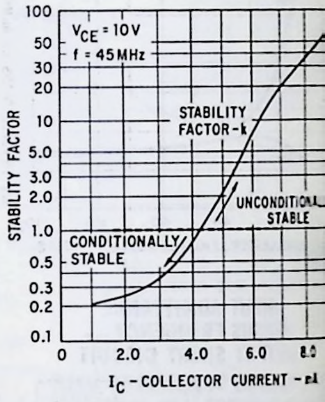
AUTOMATIC GAIN CONTROL AND NOISE FIGURE VERSUS AUTOMATIC GAIN CONTROL VOLTAGE



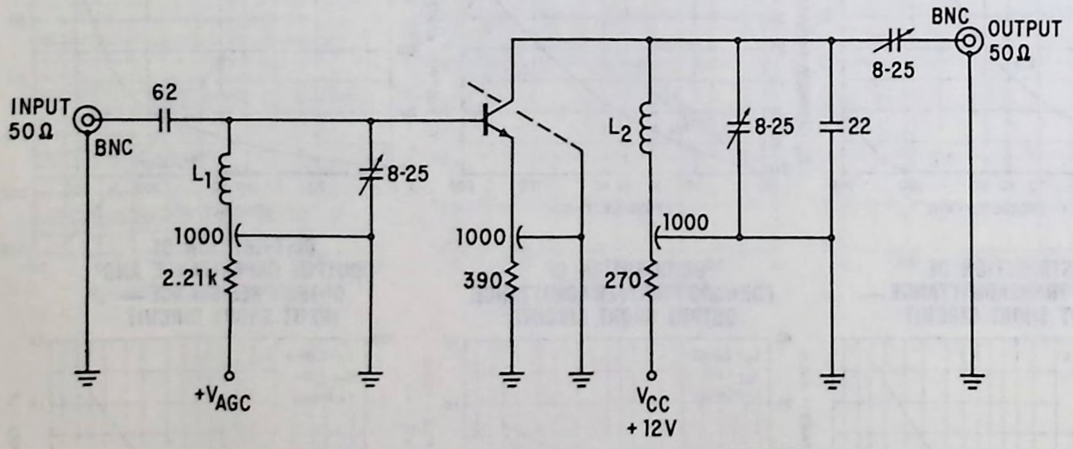
POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



STABILITY FACTOR* VERSUS COLLECTOR CURRENT



SE5055 45 MHz GAIN, NOISE FIGURE, AGC CIRCUIT


INPUT
50 Ω
BNC
62
L_1
8-25
1000
2.21k
$+V_{AGC}$
1000
390
L_2
8-25
22
1000
270
V_{CC}
+12V
8-25
BNC
OUTPUT
50 Ω

L_1—7 TURNS No. 16 BUSS WIRE 5/8" L X 5/16" I.D.

L_2—4 TURNS No. 16 BUSS WIRE 1/2" L X 1/2" I.D.

ALL CAPACITIES IN pF.

ALL RESISTANCE IN Ω, 1/2W, 1% TOL.

ERIE TUNEABLES P/N N300

ERIE FEEDTHRU P/N 370CB102J

R_g = 120 Ω

R_L = 750 Ω

FIGURE 1

* Rollett stability factor k, where $k = \frac{2\,g_i g_o - \mathrm{Re}(Y_f Y_r)}{|Y_r Y_f|}$

2N5056 · 2N5057

PNP HIGH SPEED SATURATED SWITCHES

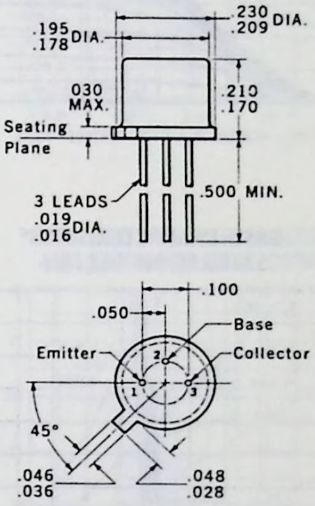
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FAST SWITCHING	**t_{on} = 20 ns (MAX) AT 30 mA**
	t_{off} = 35 ns (MAX) AT 30 mA
	τ_s = 30 ns (MAX) AT 10 mA
HIGH FREQUENCY	**f_T = 800 MHz (MIN) AT 30 mA**
LOW CAPACITANCE	**C_{cb} = 4.5 pF (MAX) AT 5 V**
LOW SATURATION VOLTAGE . . .	**V_{CE}(sat) = 0.19 V (MAX) AT I_C = 30 mA**

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	1.2 Watts
at 100°C Case Temperature	0.72 Watt
at 25°C Ambient Temperature	0.36 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	−15 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	−15 Volts
V_{EBO} Emitter to Base Voltage	−4.5 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.44 gram

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

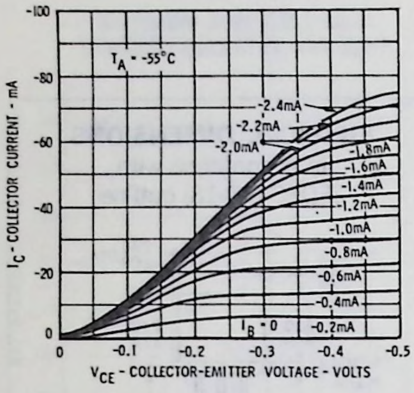
SYMBOL	CHARACTERISTICS	2N5056 MIN.	2N5056 TYP.	2N5056 MAX.	2N5057 MIN.	2N5057 TYP.	2N5057 MAX.	UNITS	TEST CONDITIONS	
t_{on}	**Turn On Time** (Note 6, Figure 1)		10	20		10	20	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	**Turn Off Time** (Note 6, Figure 1)		15	35		15	35	ns	$I_C \approx 30$ mA	$I_{B1} = I_{B2} \approx 3.0$ mA
τ_s	**Charge Storage Time** (Note 6, Figure 1)		15	30		15	30	ns	$I_C \approx 10$ mA	$I_{B1} \approx 10$ mA $I_{B2} \approx -10$ mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.08	−0.13		−0.08	−0.13	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		−0.12	−0.19		−0.12	−0.19	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		−0.28	−0.45		−0.28	−0.45	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)	−0.72	−0.82	−0.92	−0.72	−0.82	−0.92	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)	−0.80	−0.93	−1.15	−0.80	−0.93	−1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage	−0.95	−1.14	−1.5	−0.95	−1.14	−1.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	6.0	9.0		8.0	12			$I_C = 30$ mA	$V_{CE} = -10$ V
C_{cb}	**Collector to Base Capacitance**		3.3	4.5		3.3	4.5	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{eb}	Emitter to Base Capacitance		4.7	6.0		4.7	6.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
I_{CES}	Collector Reverse Current		0.3	50		0.3	50	nA	$V_{CE} = -10$ V	$V_{BE} = 0$
I_{CES}(+125°C)	Collector Reverse Current		0.05	10		0.05	10	μA	$V_{CE} = -10$ V	$V_{BE} = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	−15			−15			Volts	$I_C = 10$ mA	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−15			−15			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−15			−15			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5			−4.5			Volts	$I_C = 0$	$I_E = 100$ μA
h_{FE}	DC Pulse Current Gain (Note 5)	12	25		20	44			$I_C = 1.0$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	33		30	53			$I_C = 10$ mA	$V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	48	100	40	63	100		$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	20	45		30	55			$I_C = 100$ mA	$V_{CE} = -1.0$ V
h_{FE}(−55°C)	**DC Pulse Current Gain** (Note 5)	12	25		20	38			$I_C = 30$ mA	$V_{CE} = -0.5$ V

es on page 4

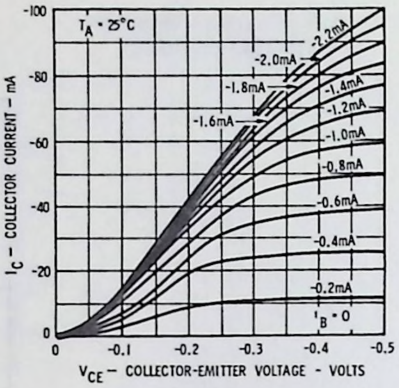
* Planar is a patented Fairchild process.

TYPICAL ELECTRICAL CHARACTERISTICS

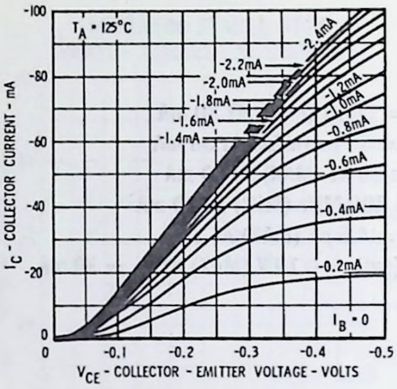
COLLECTOR CHARACTERISTICS* SATURATION REGION



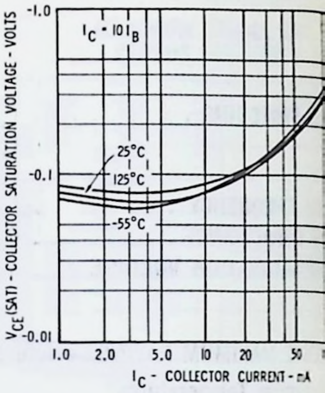
COLLECTOR CHARACTERISTICS* SATURATION REGION



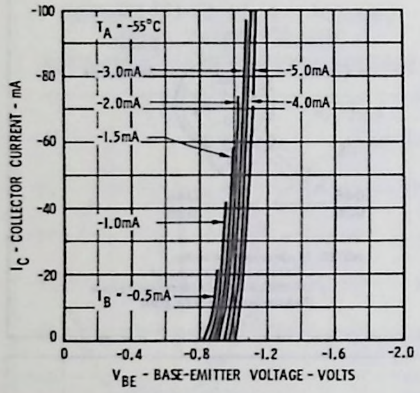
COLLECTOR CHARACTERISTICS* SATURATION REGION



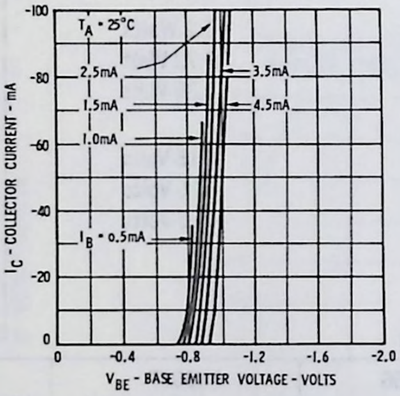
COLLECTOR SATURATION VOLT VERSUS COLLECTOR CURRE



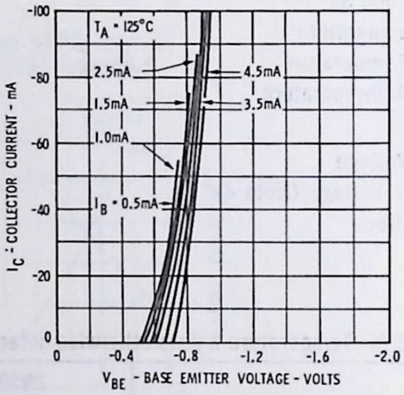
BASE CHARACTERISTICS* SATURATION REGION



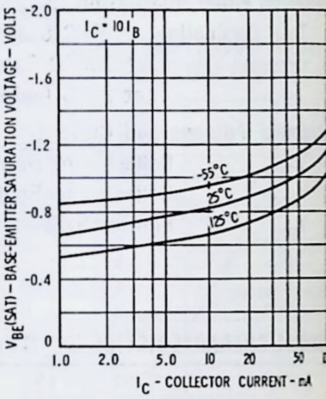
BASE CHARACTERISTICS* SATURATION REGION



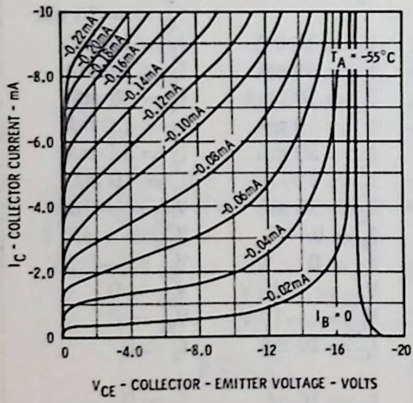
BASE CHARACTERISTICS* SATURATION REGION



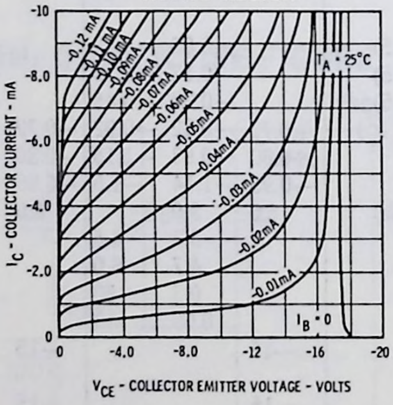
BASE SATURATION VOLTAG VERSUS COLLECTOR CURRE



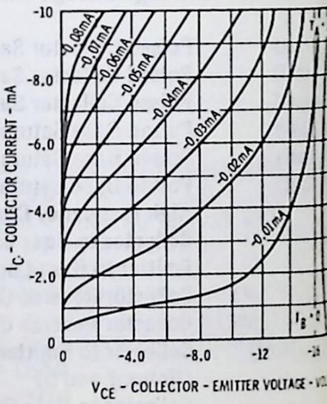
COLLECTOR CHARACTERISTICS ACTIVE REGION



COLLECTOR CHARACTERISTICS ACTIVE REGION



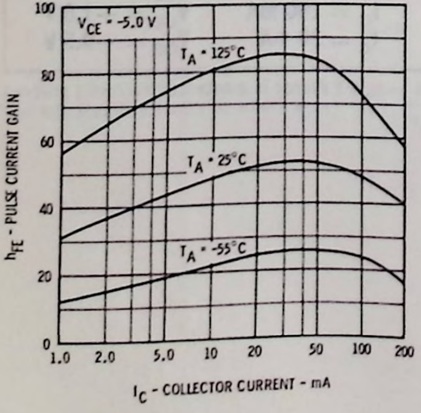
COLLECTOR CHARACTERISTI ACTIVE REGION



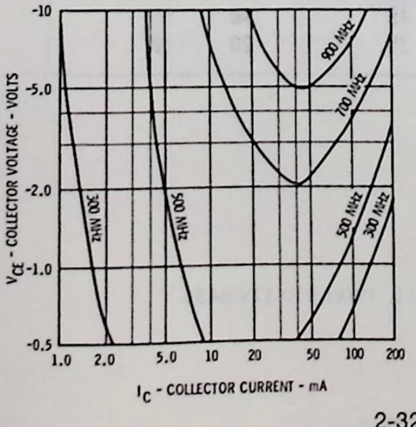
*Single family characteristics on Transistor Curve Tracer.

2N5056

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

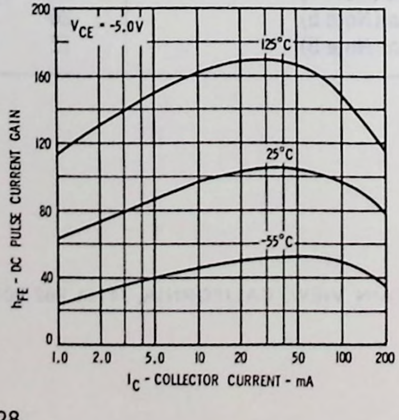


CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

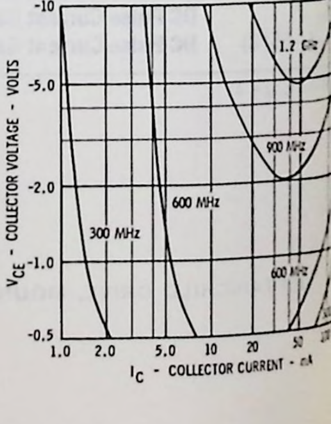


2N5057

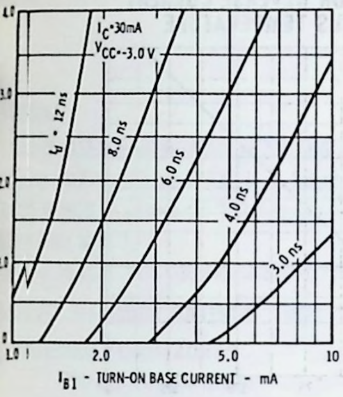
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

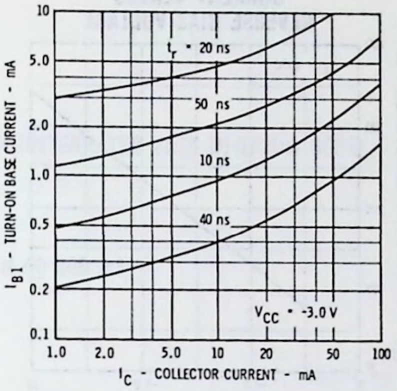


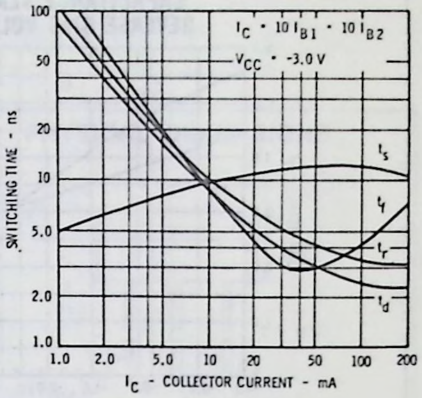
CONTOURS OF CONSTANT GA BANDWIDTH PRODUCT

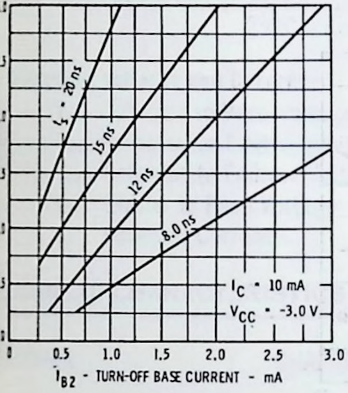


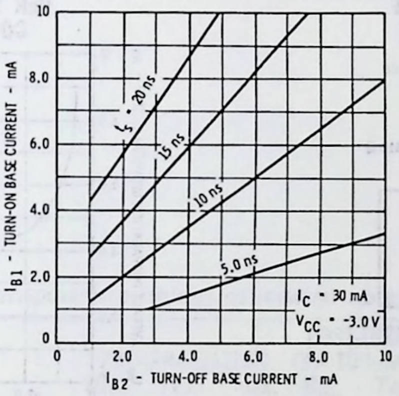
TYPICAL ELECTRICAL CHARACTERISTICS

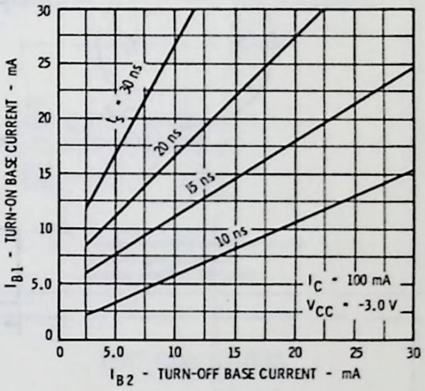

DELAY TIME VERSUS ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE

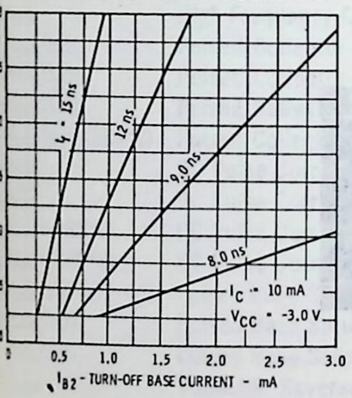

RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS

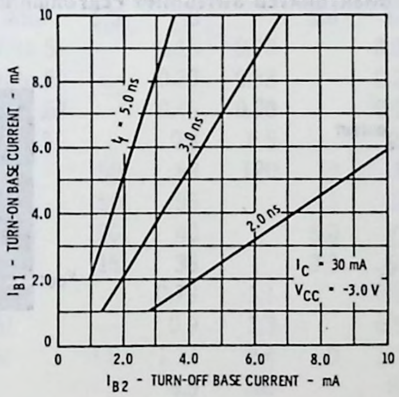

SWITCHING TIMES VERSUS COLLECTOR CURRENT

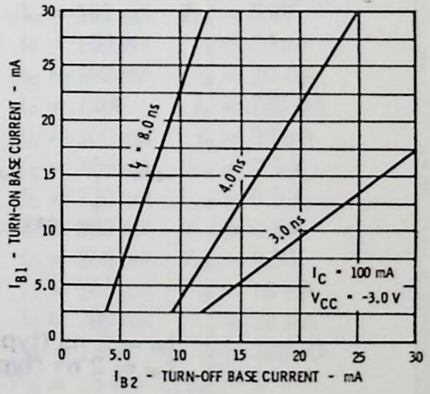

STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

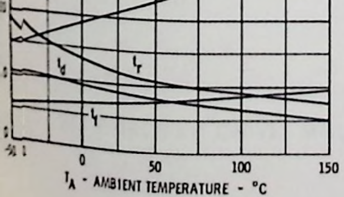

STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

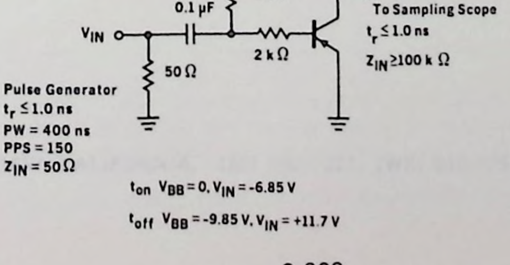

STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

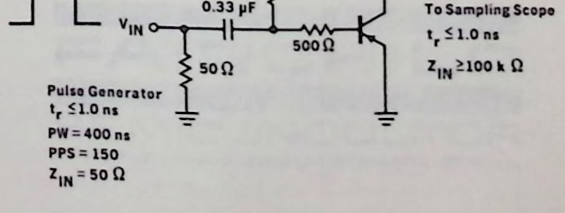

FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

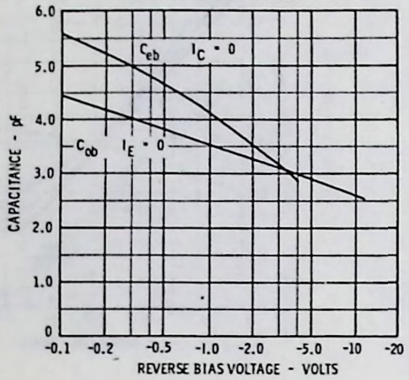

FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS


SWITCHING TIMES VERSUS TEMPERATURE

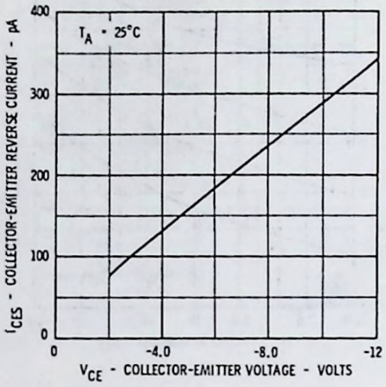

SWITCHING TIME TEST CIRCUIT FIGURE 1
-3.0 V
V_{BB}
94Ω
V_{OUT}
To Sampling Scope
t_r ≤1.0 ns
Z_{IN} ≥100 k Ω
0.1 µF
1 kΩ
2 kΩ
V_{IN}
50 Ω
Pulse Generator
t_r ≤1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω
t_{on} V_{BB} = 0, V_{IN} = -6.85 V
t_{off} V_{BB} = -9.85 V, V_{IN} = +11.7 V


SWITCHING TIME TEST CIRCUIT FIGURE 2
-3.0 V
270 Ω
V_{OUT}
To Sampling Scope
t_r ≤1.0 ns
Z_{IN} ≥100 k Ω
-11 V
500 Ω
+10 V
0.33 µF
V_{IN}
500 Ω
50 Ω
Pulse Generator
t_r ≤1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω

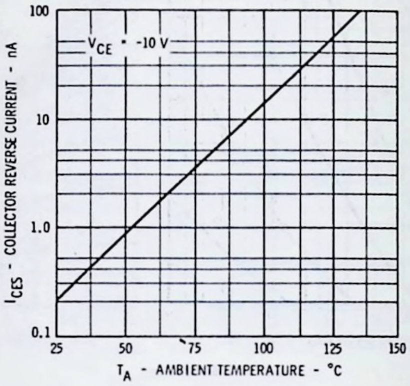
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



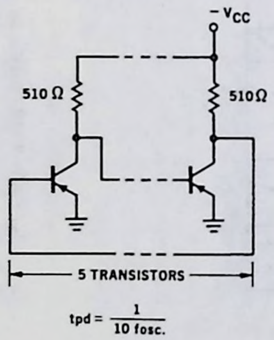
COLLECTOR-EMITTER REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



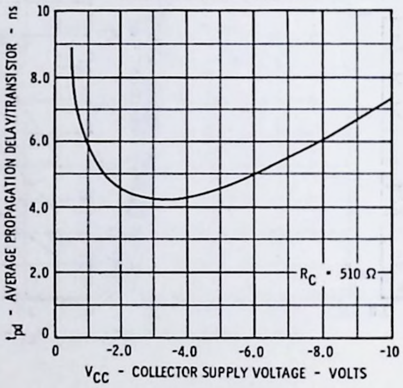
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



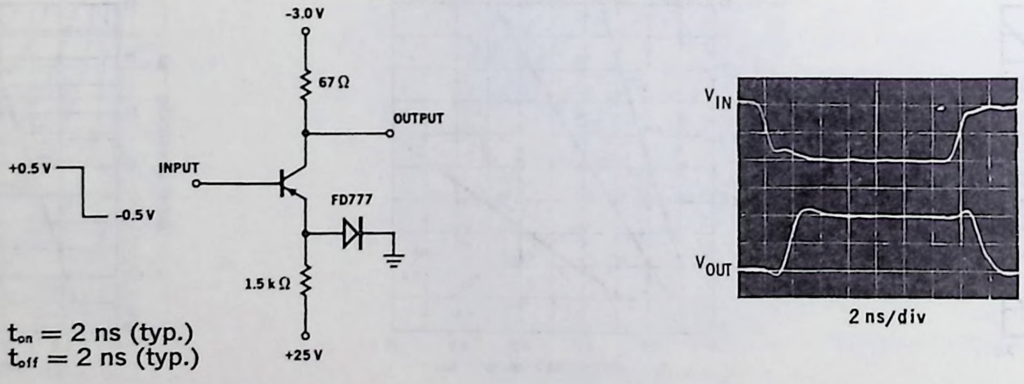
FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY



AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE



NONSATURATED SWITCHING PERFORMANCE



t_{on} = 2 ns (typ.)
t_{off} = 2 ns (typ.)

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C); junction to ambient thermal resist of 486°C/watt (derating factor of 2.06 mW/°C).
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

2N5065

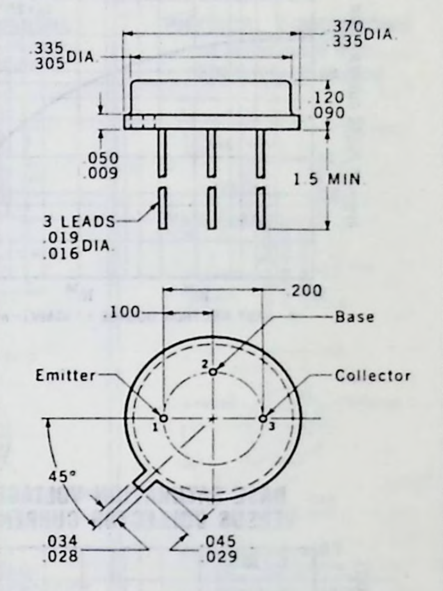
NPN HIGH SPEED HIGH CURRENT RADIATION RESISTANT SWITCH

SILICON PLANAR* EPITAXIAL TRANSISTOR

ATURES

- **GUARANTEED PERFORMANCE AFTER 3 × 10^{14} nvt > 10 keV (INTEGRATED FAST NEUTRON DOSE)**
- **15 ns MAX. t_{on}; 35 ns MAX. t_{off}; 16 ns MAX. τ_s**
- **0.95 V MAX. V_{CE} (sat) @ 1.0 Amp.**
- **500 MHz MIN. f_T**
- **h_{FE} — 10 MIN. POST-IRRADIATION; 50 MIN. PRE-IRRADIATION @ 300 mA**

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Collector internally connected to case
Leads are gold plated kovar
Package weight is 0.98 gram

SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (soldering, 60 second time limit)	+300°C

Maximum Power Dissipation [Notes 2 and 3]

Total Dissipation at 25°C Case Temperature	2.5 Watts
25°C Ambient Temperature	0.6 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	25 Volts
V_{CES}	Collector to Emitter Voltage	25 Volts
V_{CEO}	Collector to Emitter Voltage [Note 5]	15 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Collector Current	1.0 Amp.

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	PRE-IRRADIATION			POST-IRRADIATION (3×10^{14} nvt >10 keV)			UNITS	TEST CONDITIONS	
		Min.	Typ.	Max.	Min.	Typ.	Max.			
t_{on}	**Turn On Time** [Note 6]		11	**15**		11	**15**	ns	$I_C \approx 1.0$ A	$I_{B1} \approx 200$ mA
t_{off}	**Turn Off Time** [Note 6]		20	**35**		15	**35**	ns	$I_C \approx 1.0$ A	$I_{B1} = I_{B2} \approx 200$ mA
τ_s	**Charge Storage Time** [Note 6]		**13**	**16**		**8.0**	**16**	ns	$I_C \approx 100$ mA	$I_{B1} \approx 100$ mA $I_{B2} \approx -100$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	5.5	7.0		**5.0**	6.8			$I_C = 100$ mA	$V_{CE} = 5.0$V
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.15	0.23		0.21	0.30	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.20	0.33		0.29	0.42	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{CE} (sat)	**Pulsed Collector Saturation Voltage** [Note 5]		0.45	**0.70**		0.59	**0.95**	**Volts**	$I_C = 1.0$A	$I_B = 200$ mA
V_{CE} (sat) (125°C)	Pulsed Collector Saturation Voltage [Note 5]		0.3	0.5		0.4	0.6	Volts	$I_C = 300$ mA	$I_B = 30$ mA
h_{FE}	DC Pulse Current Gain [Note 5]	50	88	120	10	19			$I_C = 300$ mA	$V_{CE} = 0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	50	96		11	20			$I_C = 100$ mA	$V_{CE} = 0.5$ V
h_{FE} (−35°C)	DC Pulse Current Gain [Note 5]	20	40		5.0	7.0			$I_C = 300$ mA	$V_{CE} = 0.5$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	15	36		3.0	5.0			$I_C = 300$ mA	$V_{CE} = 0.5$ V
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		0.79	1.1		0.81	1.1	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		0.9	1.3		0.91	1.3	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	1.0	1.17	2.4	1.0	1.24	2.4	Volts	$I_C = 1.0$ A	$I_B = 200$ mA
I_{CES}	Collector Reverse Current		8.5	100		8.5	100	μA	$V_{CE} = 15$ V	$V_{EB} = 0$
I_{CES} (125°C)	Collector Reverse Current			150			150	μA	$V_{CE} = 15$ V	$V_{EB} = 0$
C_{cb}	Collector to Base Capacitance		6.0	15		6.0	15	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter to Base Capacitance		15	25		15	25	pF	$I_C = 0$	$V_{EB} = 0.5$ V
BV_{CES}	Collector to Emitter Breakdown Voltage	25	46		25	54		Volts	$I_C = 0.5$ mA	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	25			25			Volts	$I_C = 0.5$ mA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 5]	15	17.5		15	23		Volts	$I_C = 30$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	5.7		4.0	5.8		Volts	$I_C = 0$	$I_E = 0.1$ mA

* Planar is a patented Fairchild process.

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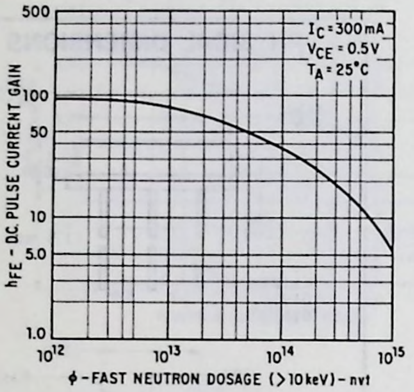
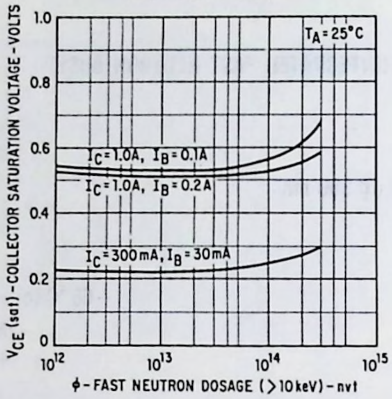
TYPICAL ELECTRICAL CHARACTERISTICS

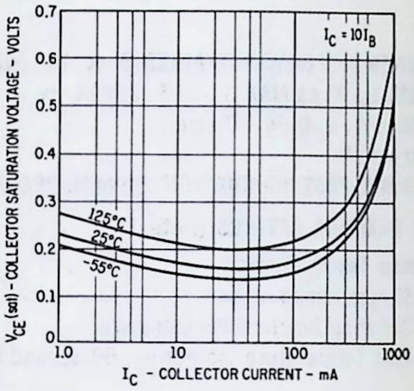
DC CURRENT GAIN VERSUS NEUTRON DOSAGE



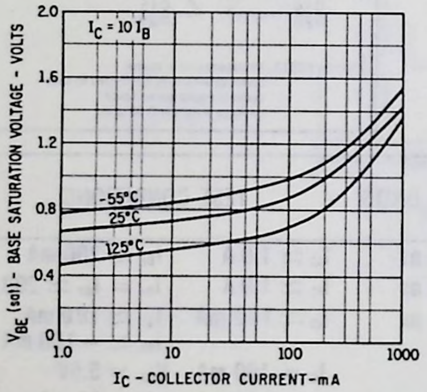
COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE



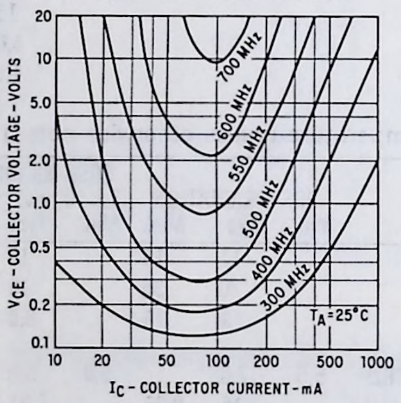
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



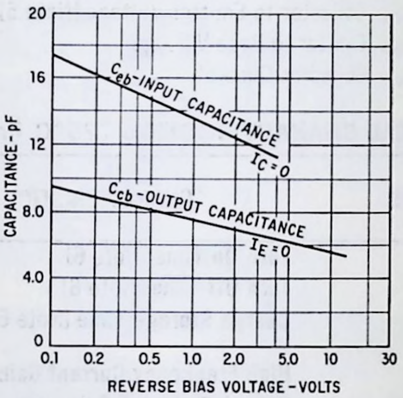
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



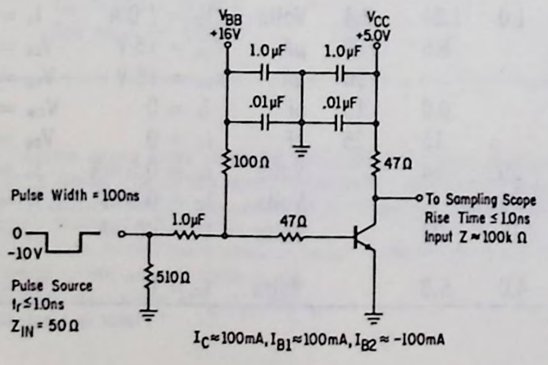
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



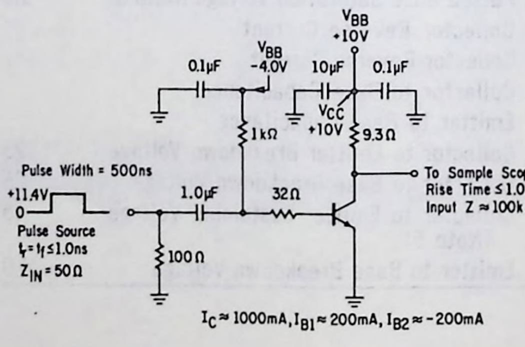
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



CHARGE STORAGE TIME MEASUREMENT CIRCUIT


V_{BB}
+16V
V_{CC}
+5.0V
1.0µF
1.0µF
.01µF
.01µF
100Ω
47Ω
Pulse Width = 100ns
0
-10V
1.0µF
47Ω
510Ω
Pulse Source
$t_r \leq$ 1.0ns
Z_{IN} = 50Ω
To Sampling Scope
Rise Time ≤ 1.0ns
Input Z ≈ 100k Ω
I_C ≈ 100mA, I_{B1} ≈ 100mA, I_{B2} ≈ -100mA

t_{on} AND t_{off} MEASUREMENT CIRCUIT


V_{BB}
+10V
V_{BB}
-4.0V
0.1µF
10µF
0.1µF
V_{CC}
+10V
1kΩ
9.3Ω
Pulse Width = 500ns
+11.4V
0
1.0µF
32Ω
100Ω
Pulse Source
$t_r = t_f \leq$ 1.0ns
Z_{IN} = 50Ω
To Sample Scope
Rise Time ≤ 1.0ns
Input Z ≈ 100k Ω
I_C ≈ 1000mA, I_{B1} ≈ 200mA, I_{B2} ≈ -200mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C); junction to ambient thermal resistance of 291.7°C/Watt (derating factor of 3.43 mW/°C).
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 µs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

2N5106 • 2N5107

NPN RADIATION RESISTANT GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DOUBLE DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GUARANTEED PERFORMANCE AFTER NEUTRON IRRADIATION OF 3 x 10^{14} nvt > 10 keV

GAIN . . . . h_{FE} = 8.0 (MIN), 13 (TYP) AT 150 mA
h_{FE} = 100 (MIN) AT 150 mA PREIRRADIATION
f_T = 200 MHz (MIN) AT 50 mA

BREAKDOWN VOLTAGE . . . LV_{CEO} = 30 V (MIN)

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

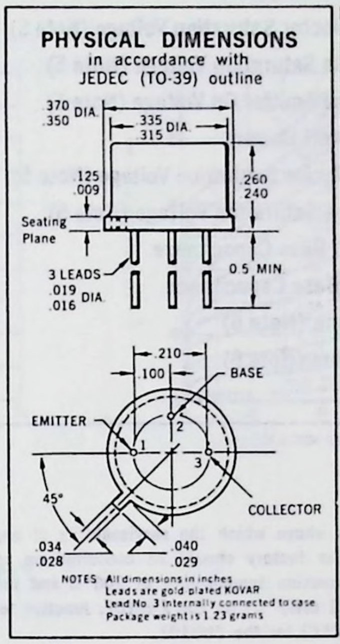
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation (Notes 2 and 3)	**2N5106**	**2N5107**
Total Dissipation at 25°C Case Temperature	3.0 Watts	1.8 Watts
at 25°C Ambient Temperature	0.8 Watt	0.36 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts
I_C	Collector Current	500 mA	500 mA

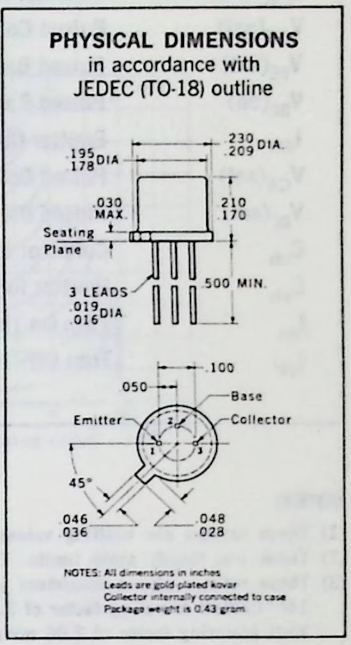
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

2N5106

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

2N5107

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		PRE-IRRADIATION			POST-IRRADIATION (3 x 10^{14} nvt > 10 keV)					
YMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$_{CEO}$(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**30**	**42**		**30**	**56**		**Volts**	**I_C = 10 mA**	**I_B = 0**
V_{CES}	Collector to Emitter Breakdown Voltage	60	80		60	87		Volts	I_C = 10 μA	V_{BE} = 0
V_{CBO}	Collector to Base Breakdown Voltage	60			60			Volts	I_C = 10 μA	I_E = 0
V_{EBO}	Emitter to Base Breakdown Voltage	5.0	7.0		5.0	7.0		Volts	I_C = 0	I_E = 10μ A
$_{FE}$	DC Pulse Current Gain (Note 5)	50	100		5.0	9.0			I_C = 1.0 mA	V_{CE} = 10 V
$_{FE}$	DC Pulse Current Gain (Note 5)	75	205		8.0	16			I_C = 10 mA	V_{CE} = 10 V
$_{FE}$	DC Pulse Current Gain (Note 5)	50			5.0				I_C = 150 mA	V_{CE} = 1.0 V
$_{FE}$	**DC Pulse Current Gain** (Note 5)	**100**	**220**	**300**	**8.0**	**13**			**I_C = 150 mA**	**V_{CE} = 10 V**
$_{FE}$(−35°C)	DC Pulse Current Gain (Note 5)	50			5.0				I_C = 150 mA	V_{CE} = 10 V
$_{FE}$(−55°C)	DC Pulse Current Gain (Note 5)	35			3.0				I_C = 150 mA	V_{CE} = 10 V
$_{FE}$	DC Pulse Current Gain (Note 5)	50	100		5.0	9.0			I_C = 500 mA	V_{CE} = 10 V
$_{fe}$	**High Frequency Current Gain (f = 100 MHz)**	**2.5**	**4.5**	**9.0**	**2.0**	**4.0**			**I_C = 50 mA**	**V_{CE} = 10 V**

*Planar is a patented Fairchild process.

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

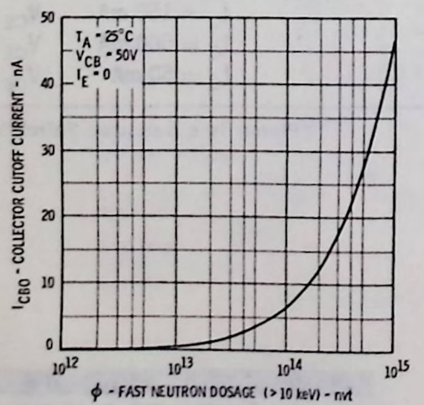
SYMBOL	CHARACTERISTIC	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST-IRRADIATION (3×10^{14} nvt > 10 keV) MIN.	POST-IRRADIATION (3×10^{14} nvt > 10 keV) TYP.	POST-IRRADIATION (3×10^{14} nvt > 10 keV) MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	Collector Cutoff Current		0.2	10		18	100	nA	$I_E = 0$	$V_{CB} = 50$ V
I_{CBO}(150°C)	Collector Cutoff Current			10			100	μA	$I_E = 0$	$V_{CB} = 50$ V
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		0.11	0.22		0.33	0.5	Volts	$I_C = 150$ mA	$I_B = 50$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)			1.5			1.5	Volts	$I_C = 150$ mA	$I_B = 50$ mA
V_{BE}(on)	Pulsed Base Emitter On Voltage (Note 5)			1.2			1.2	Volts	$I_C = 150$ mA	$V_{CE} = 10$ V
I_{EBO}	Emitter Cutoff Current		0.1	10			100	nA	$I_C = 0$	$V_{EB} = 3.0$ V
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)			0.45			1.6	Volts	$I_C = 300$ mA	$I_B = 100$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)			1.5			1.6	Volts	$I_C = 300$ mA	$I_B = 100$ mA
C_{cb}	Collector to Base Capacitance		6.0	8.0			8.0	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter to Base Capacitance		14	20			20	pF	$I_C = 0$	$V_{EB} = 2.0$ V
t_{on}	Turn On Time (Note 6)			65			65	ns	$I_C \approx 300$ mA	$I_{B1} \approx 100$ mA
t_{off}	Turn Off Time (Note 6)			550			550	ns	$I_C \approx 300$ mA	$I_{B1} \approx 100$ mA $I_{B2} \approx -100$

NOTES:

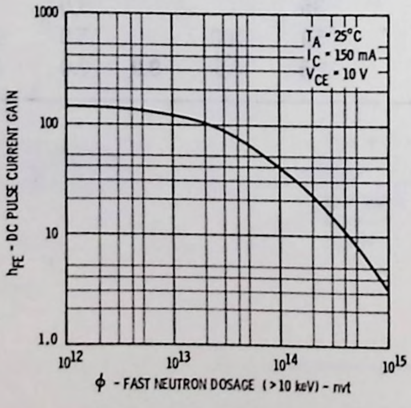
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C) for the 2N5106 140°C/Watt (derating factor of 7.1 mW/°C) for the 2N5107. Junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.57 mW/°C) for the 2N5106 and 455°C/Watt (derating factor of 2.06 mW/°C) for the 2N5107.
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

TYPICAL ELECTRICAL CHARACTERISTICS

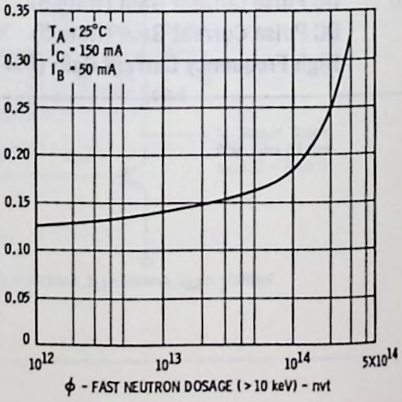
COLLECTOR CUTOFF CURRENT VERSUS FAST NEUTRON DOSAGE



DC PULSE CURRENT GAIN VERSUS FAST NEUTRON DOSAGE

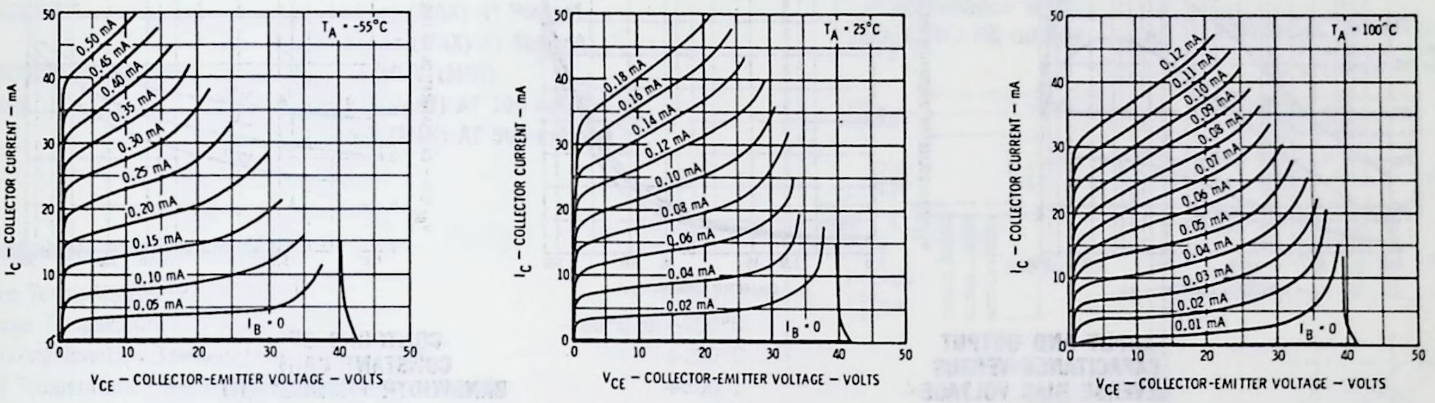


COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE

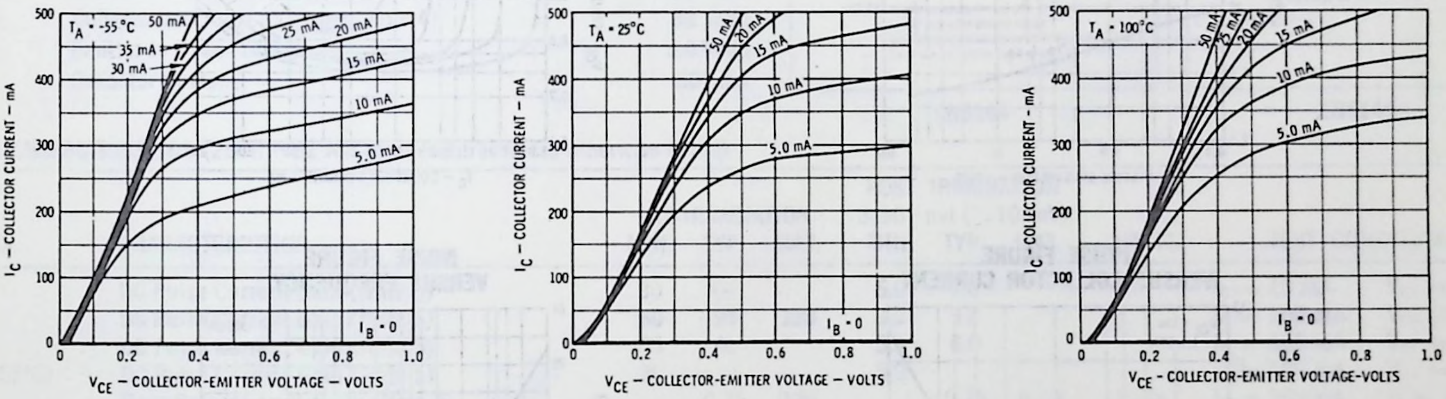


TYPICAL COLLECTOR CHARACTERISTICS*

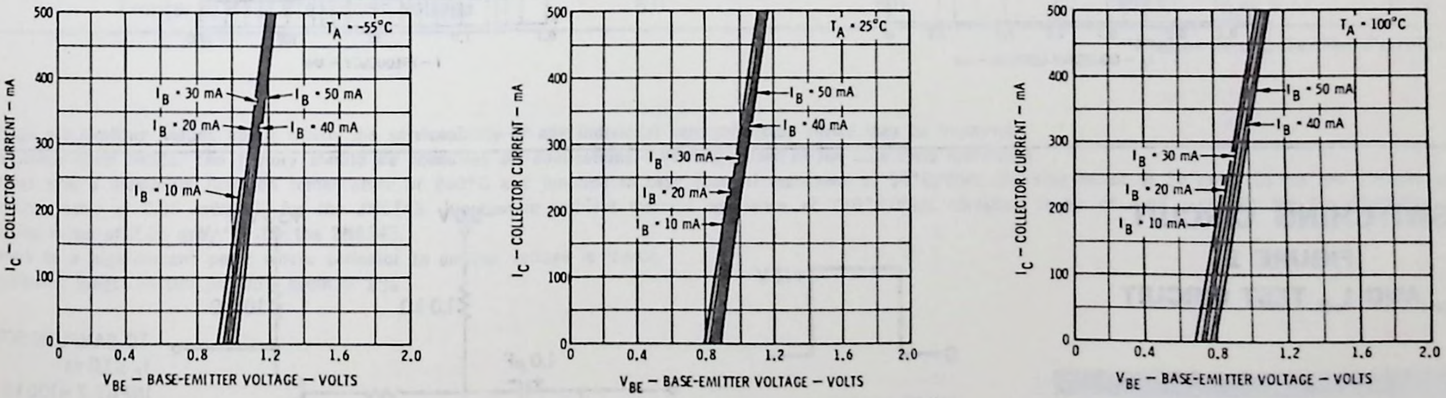
ACTIVE REGION*



SATURATION REGION*



TYPICAL BASE CHARACTERISTICS*



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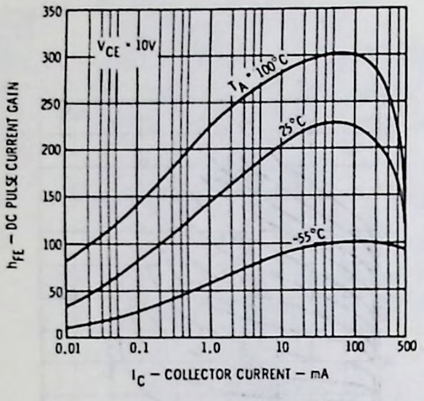
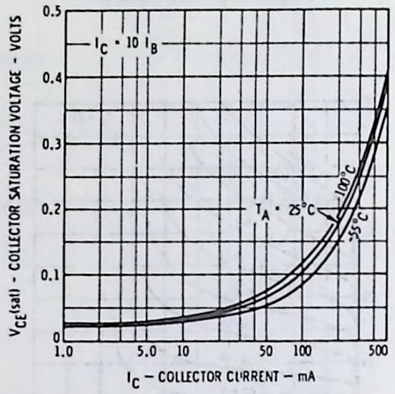
*Sinngle family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

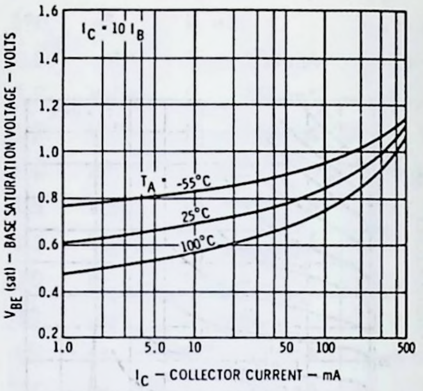
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



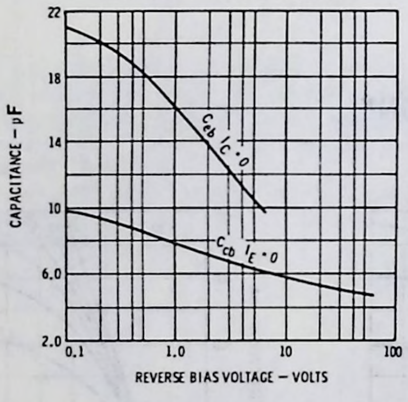
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



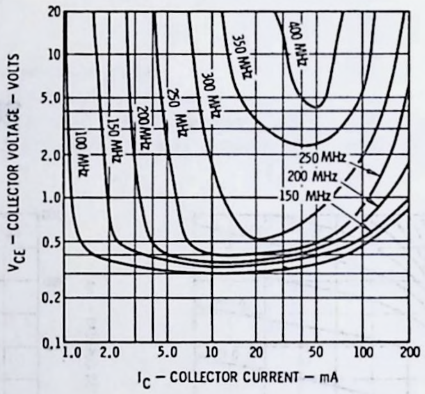
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



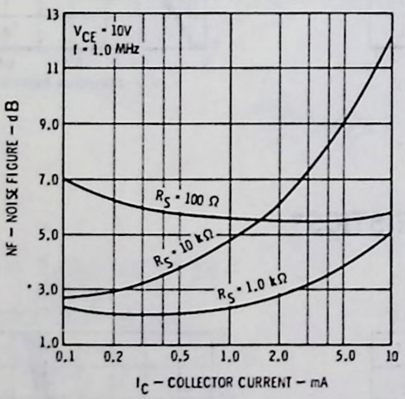
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



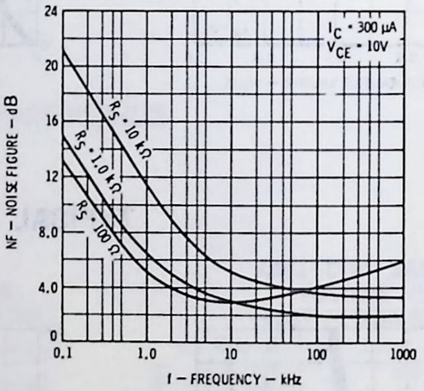
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



NOISE FIGURE VERSUS COLLECTOR CURRENT



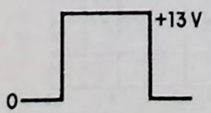
NOISE FIGURE VERSUS FREQUENCY



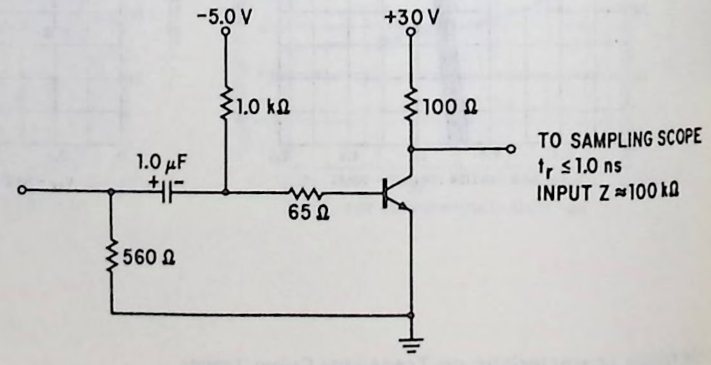
SWITCHING CIRCUIT

FIGURE 1

t_{on} AND t_{off} TEST CIRCUIT



PULSE WIDTH = 2.5 μS
t_r ≤ 1.0 ns
t_f ≤ 20 ns
DUTY CYCLE ≤ 2%
Z_{IN} = 50 Ω



-5.0 V
+30 V
1.0 kΩ
100 Ω
1.0 μF
+ –
65 Ω
560 Ω
TO SAMPLING SCOPE
t_r ≤ 1.0 ns
INPUT Z ≈ 100 kΩ

2N5144 • 2N5145

NPN RADIATION RESISTANT HIGH-VOLTAGE, HIGH-SPEED SWITCHES

DOUBLE DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GUARANTEED PERFORMANCE AFTER NEUTRON IRRADIATION
OF 3 x 10¹⁴ nvt > 10 keV

FAST SWITCHING . . . . t_{on} = 35 ns (MAX) AT 500 mA
t_{off} = 60 ns (MAX) AT 500 mA
HIGH BREAKDOWN VOLTAGE . . . LV_{CEO} = 30 V (MIN)
HIGH GAIN . . . . h_{FE} = 9.0 (MIN) AT 100 mA, 1.0 V
h_{FE} = 5.0 (MIN) AT 500 mA, 1.0 V

SOLUTE MAXIMUM RATINGS (Note 1)

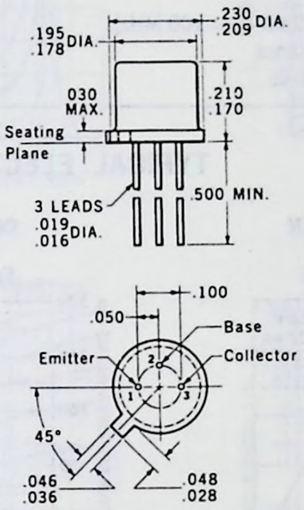
Maximum Temperatures

Storage Temperature		−65°C to +200°C
Operating Junction Temperature		+200°C
Lead Temperature (Soldering, 60 second time limit)		+300°C
Maximum Power Dissipation (Notes 2 and 3)	**2N5144**	**2N5145**
Total Dissipation at 25°C Case Temperature	1.2 Watts	3.5 Watts
at 25°C Ambient Temperature	0.36 Watt	0.8 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	50 Volts
V_{CES}	Collector to Emitter Voltage	50 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	500 mA

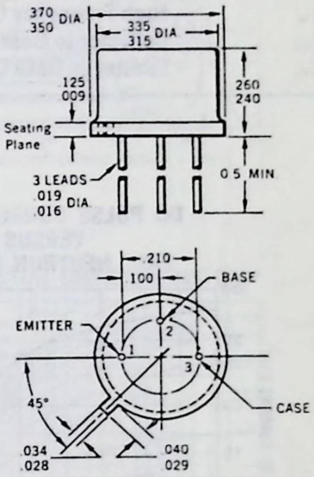
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.44 gram

2N5144

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES All dimensions in inches
Leads are gold plated KOVAR
Lead No 3 internally connected to case
Package weight is 1 23 grams

2N5145

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST IRRADIATION 3x10¹⁴ nvt (>10 keV) MIN.	POST IRRADIATION 3x10¹⁴ nvt (>10 keV) TYP.	POST IRRADIATION 3x10¹⁴ nvt (>10 keV) MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	30	60		5.0	7.0			I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**60**	**90**	**150**	**9.0**	**12**			**I_C = 100 mA**	**V_{CE} = 1.0 V**
h_{FE}	**DC Pulse Current Gain** (Note 5)	**35**	**50**		**5.0**	**6.0**			**I_C = 500 mA**	**V_{CE} = 1.0 V**
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	30			5.0				I_C = 100 mA	V_{CE} = 1.0 V
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.75	0.86		0.79	0.90	Volts	I_C = 100 mA	I_B = 10 mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.78	0.90		0.82	0.95	Volts	I_C = 100 mA	I_B = 20 mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)	0.9	0.95	1.2	0.8	0.99	1.3	Volts	I_C = 500 mA	I_B = 50 mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)	0.9	1.0	1.3	0.9	1.1	1.5	Volts	I_C = 500 mA	I_B = 100 mA
I_{CBO}	Collector Cutoff Current		0.25	1.7			1.7	μA	I_E = 0	V_{CB} = 40 V
I_{CBO}(+100°C)	Collector Cutoff Current		25	120			120	μA	I_E = 0	V_{CB} = 40 V
BV_{CBO}	Collector to Base Breakdown Voltage	50			50			Volts	I_C = 10 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	50			50			Volts	I_C = 10 μA	V_{BE} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	I_C = 0	I_E = 10 μA

*Planar is a patented Fairchild process.

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C) for the 2N5144 and 146°C/Watt (derating factor of 6.85 mW/°C) for the 2N5145. Junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the 2N5144 and 485°C/Watt (derating factor of 2.06 mW/°C) for the 2N5145.

Rating refers to a high-current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

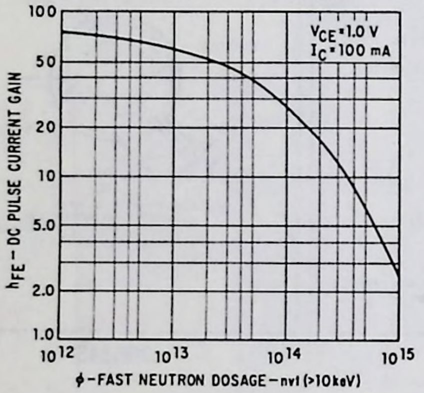
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

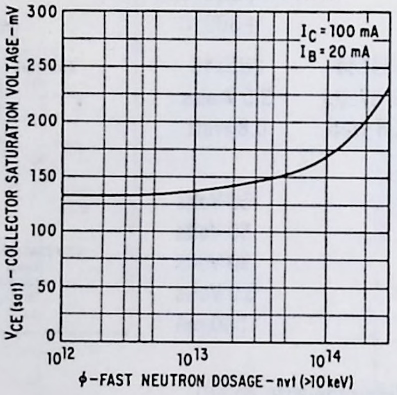
SYMBOL	CHARACTERISTICS	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST IRRADIATION 3×10^{14} nvt (>10 keV) MIN.	POST IRRADIATION TYP.	POST IRRADIATION MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**30**			**30**			**Volts**	**$I_C = 10$ mA**	$I_B = 0$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.13	0.2				Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.11	0.18		0.23	0.4	Volts	$I_C = 100$ mA	$I_B = 20$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.3	0.42				Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.27	0.4		0.56	1.1	Volts	$I_C = 500$ mA	$I_B = 100$ mA
t_{on}	**Turn On Time** (See circuit below)			**35**			**35**	**ns**	**$I_C \approx 500$ mA**	$I_{B1} \approx 100$ mA
t_{off}	**Turn Off Time** (See circuit below)			**60**			**60**	**ns**	**$I_C \approx 500$ mA**	$I_{B1} \approx 100$ mA $I_{B2} \approx -100$ m
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	4.5		2.5	4.0			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{cb}	Collector to Base Capacitance			12			12	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter to Base Capacitance			55			55	pF	$I_C = 0$	$V_{EB} = 0.5$ V

TYPICAL ELECTRICAL CHARACTERISTICS

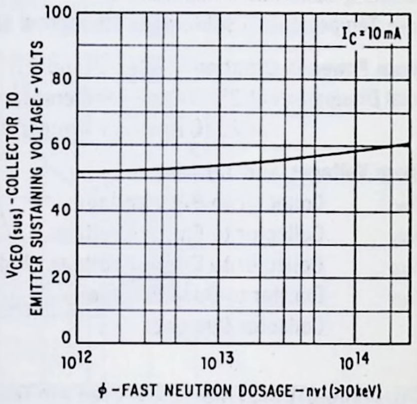
DC PULSE CURRENT GAIN VERSUS FAST NEUTRON DOSAGE



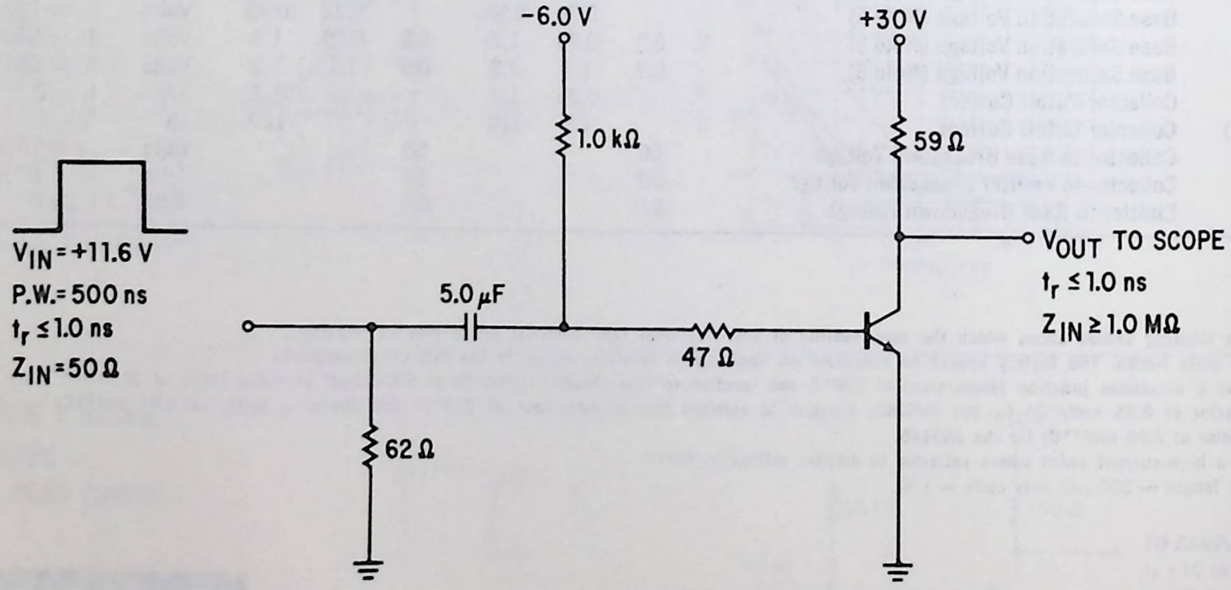
COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE



COLLECTOR TO EMITTER SUSTAINING VOLTAGE VERSUS FAST NEUTRON DOSAGE



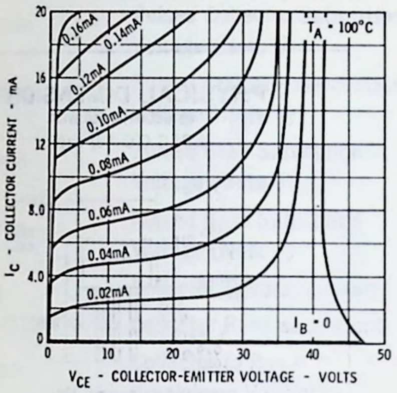
t_{on}, t_{off} TEST CIRCUIT



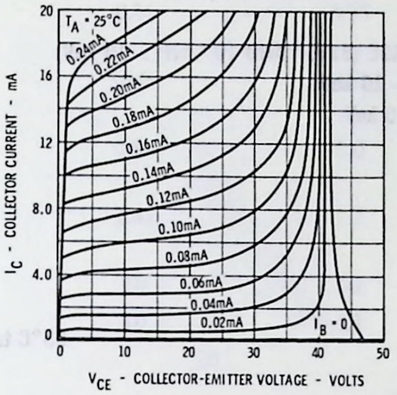
FAIRCHILD TRANSISTORS 2N5144 • 2N5145

TYPICAL ELECTRICAL CHARACTERISTICS

COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



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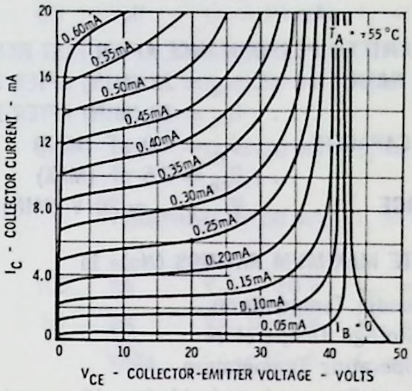

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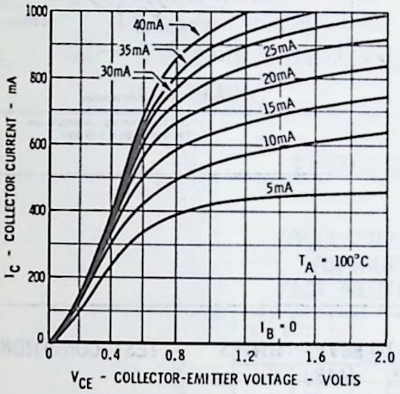
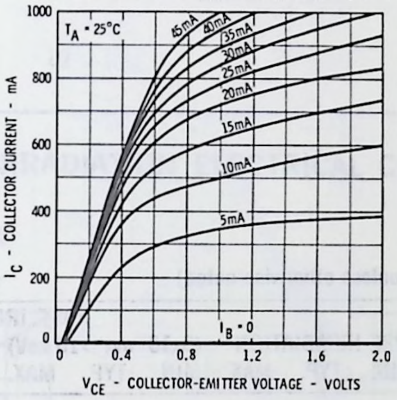


COLLECTOR CHARACTERISTICS*



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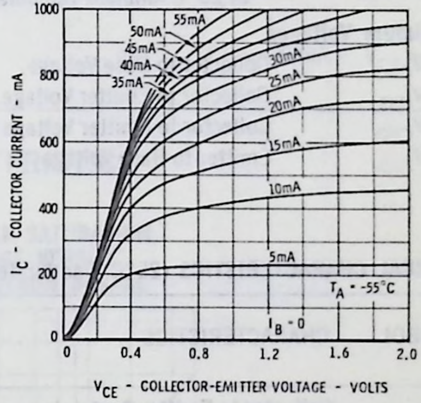
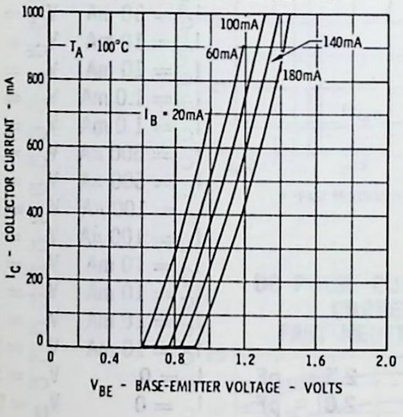
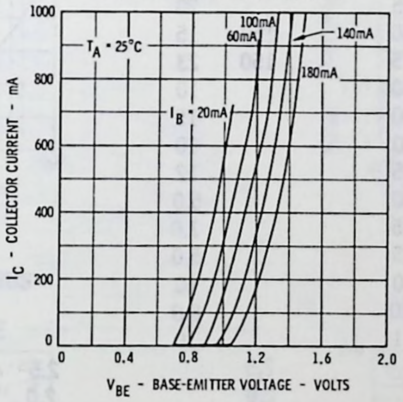


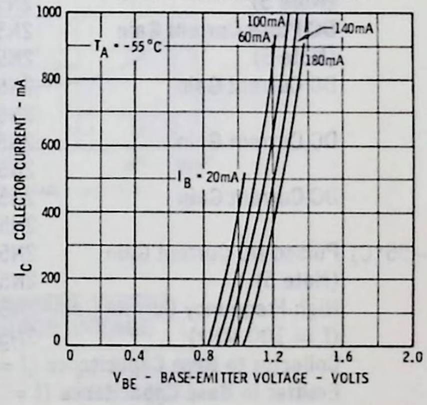
BASE CHARACTERISTICS*



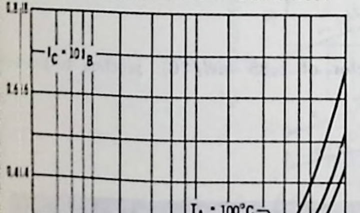
BASE CHARACTERISTICS*



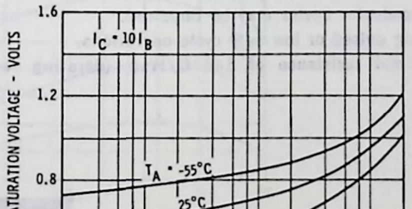
BASE CHARACTERISTICS*



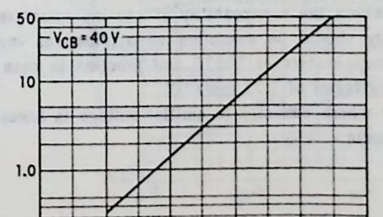
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



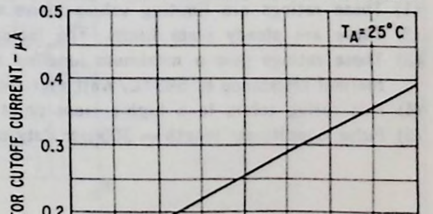
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



*Single family characteristics on Transistor Curve Tracer.

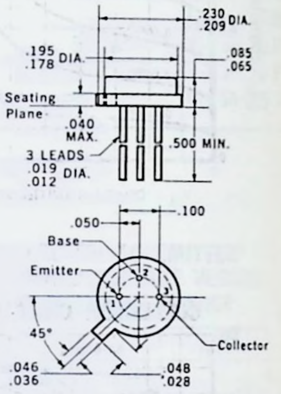
2N5200 • 2N5201

NPN RADIATION RESISTANT GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE (3×10^{14} AND 10^{15} nvt > 10 keV)**
- **HIGH GAIN . . . . . $h_{FE} = 23$ (MIN) AFTER 3×10^{14} nvt > 10 keV**
  . . . . . $h_{FE} = 10$ (MIN) AFTER 10^{15} nvt > 10 keV
- **LOW CAPACITY . . . $C_{eb} = 2.0$ pF (MAX)**
  . . . $C_{cb} = 2.5$ pF (MAX)
- **VOLTAGE . . . . . . $V_{CEO(sus)} = 20$ V (MIN)**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−55°C to +200°C
Operating Temperature		+200°C
Lead Temperature (soldering, 10 seconds time limit)		+300°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature		1.2 Watts
at 25°C Ambient Temperature		0.3 Watt
Maximum Voltages		
V_{CBO}	Collector to Base Voltage	20 Volts
V_{CES}	Collector to Emitter Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS		PRE-IRRADIATION MIN.	TYP.	MAX.	POST IRRADIATION (3×10^{14}nvt>10 keV) MIN.	TYP.	MAX.	POST IRRADIATION (10^{15}nvt>10 keV) MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage (Note 4)**		20			20			20			Volts	$I_C = 2.0$ mA	$I_B = 0$
h_{FE}	DC Pulse Current Gain	2N5200	45			15			5.0				$I_C = 30$ mA	$V_{CE} = 5.0$V
	(Note 5)	2N5201	65			20			7.0				$I_C = 30$ mA	$V_{CE} = 5.0$V
h_{FE}	**DC Pulse Current Gain**	2N5200	50		150	15			5.0				$I_C = 10$ mA	$V_{CE} = 5.0$V
	(Note 5)	**2N5201**	**75**		**150**	**23**			**10**				$I_C = 10$ mA	$V_{CE} = 5.0$V
h_{FE}	DC Current Gain	2N5200	40			10							$I_C = 1.0$ mA	$V_{CE} = 5.0$V
		2N5201	70			15			5.0				$I_C = 1.0$ mA	$V_{CE} = 5.0$V
h_{FE}	DC Current Gain	2N5200	40			10							$I_C = 500\ \mu$A	$V_{CE} = 5.0$V
		2N5201	65			12							$I_C = 500\ \mu$A	$V_{CE} = 5.0$V
h_{FE}	DC Current Gain	2N5200	40			5.0							$I_C = 100\ \mu$A	$V_{CE} = 5.0$V
		2N5201	65			7.0							$I_C = 100\ \mu$A	$V_{CE} = 5.0$V
$h_{FE}(-55°C)$	Pulsed DC Current Gain	2N5200	25			5.0							$I_C = 10$ mA	$V_{CE} = 5.0$V
	(Note 5)	2N5201	40			10			5.0				$I_C = 10$ mA	$V_{CE} = 5.0$V
h_{fe}	High Frequency Current Gain	2N5200	9.0			8.0			7.0				$I_C = 10$ mA	$V_{CE} = 5.0$V
	(f = 100 MHz)	2N5201	11			10			7.0				$I_C = 10$ mA	$V_{CE} = 5.0$V
C_{cb}	**Collector to Base Capacitance** (f = 1.0 MHz)				2.5			2.5			2.5	pF	$I_E = 0$	$V_{CB} = 5.0$V
C_{eb}	**Emitter to Base Capacitance** (f = 1.0 MHz)				2.0			2.0			2.0	pF	$I_C = 0$	$V_{EB} = 0.5$V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.85 mW/°C); junction to amb thermal resistance of 583°C/Watt (derating factor of 1.72 mW/°C).
(4) This rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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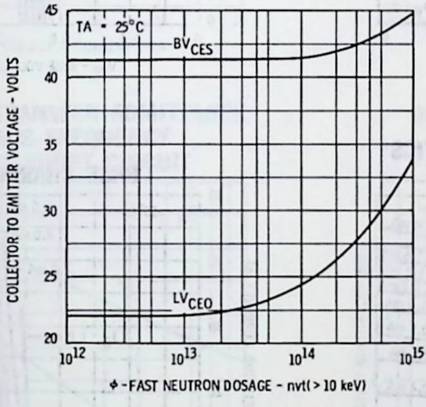
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

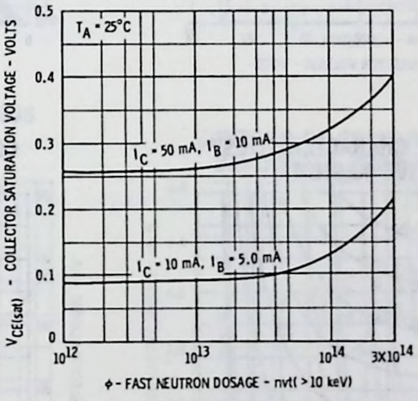
SYMBOL	CHARACTERISTICS	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST IRRADIATION (3x10^{14}nvt>10 keV) MIN.	POST IRRADIATION (3x10^{14}nvt>10 keV) TYP.	POST IRRADIATION (3x10^{14}nvt>10 keV) MAX.	POST IRRADIATION (10^{15}nvt>10 keV) MIN.	POST IRRADIATION (10^{15}nvt>10 keV) TYP.	POST IRRADIATION (10^{15}nvt>10 keV) MAX.	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)			0.15			0.35			0.7	Volt	$I_C = 10$ mA $I_B = 2.0$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)			0.5			1.0				Volt	$I_C = 50$ mA $I_B = 10$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)			0.96			1.0			1.0	Volt	$I_C = 10$ mA $I_B = 1.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)			1.42			1.7				Volts	$I_C = 50$ mA $I_B = 5.0$ mA
I_{CES}	Collector Reverse Current			10			50			100	nA	$V_{CE} = 10$ V $V_{BE} = 0$
I_{CES}(125°C)	Collector Reverse Current			10			20			50	μA	$V_{CE} = 10$ V $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	20			20			20			Volts	$I_C = 10$ μA $I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	20			20			20			Volts	$I_C = 10$ μA $V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			4.5			4.5			Volts	$I_C = 0$ $I_E = 10$μA
$r_b'C_c$	Collector Base Time Constant (f = 80 MHz)		10								ps	$I_C = 10$ mA $V_{CE} = 5.0$ V

TYPICAL POST-IRRADIATION ELECTRICAL CHARACTERISTICS

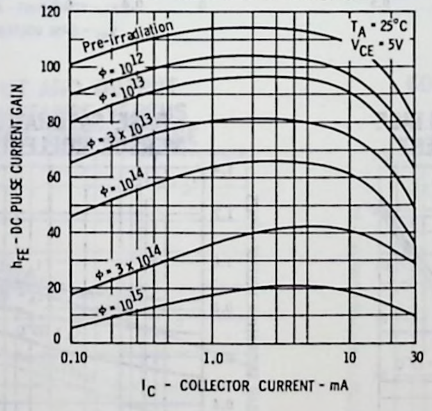
COLLECTOR TO EMITTER VOLTAGES VERSUS FAST NEUTRON DOSAGE



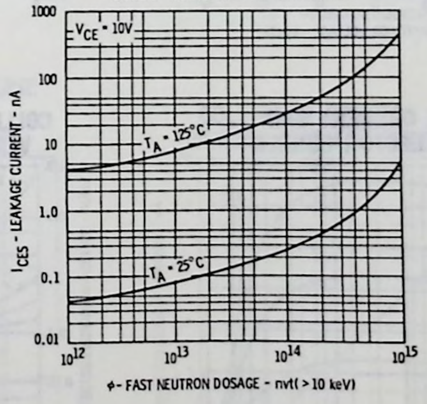
COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE



DC PULSE CURRENT VERSUS CURRENT AND FAST NEUTRON DOSAGE

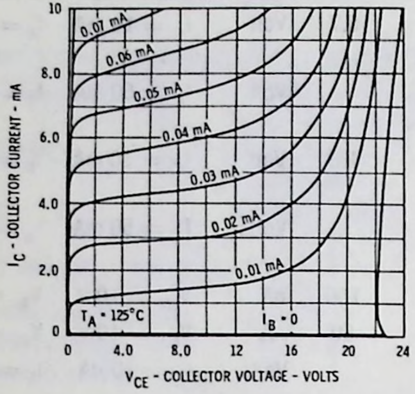


LEAKAGE CURRENT VERSUS FAST NEUTRON DOSAGE

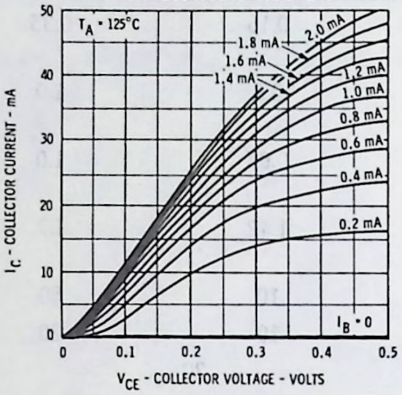


TYPICAL ELECTRICAL CHARACTERISTICS

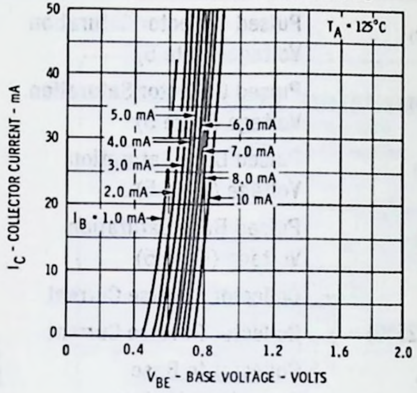
COLLECTOR CHARACTERISTICS° ACTIVE REGION



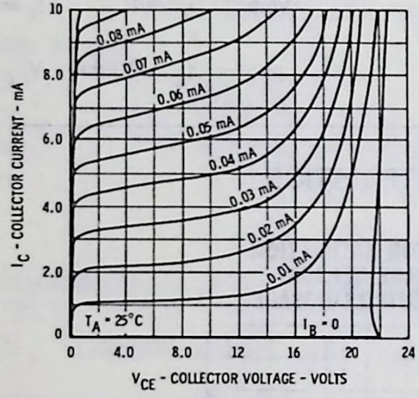
COLLECTOR CHARACTERISTICS° SATURATION REGION



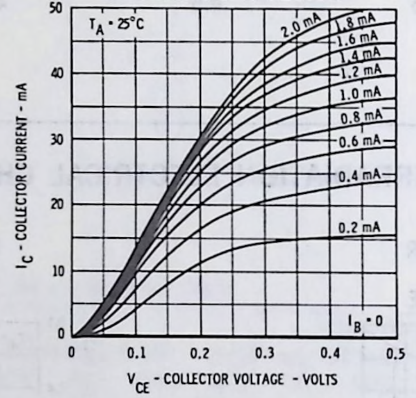
BASE CHARACTERISTICS°



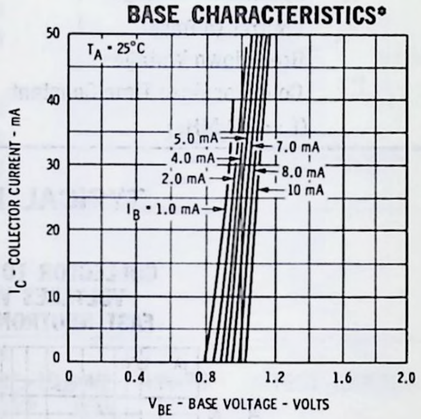
COLLECTOR CHARACTERISTICS° ACTIVE REGION



COLLECTOR CHARACTERISTICS° SATURATION REGION



BASE CHARACTERISTICS°



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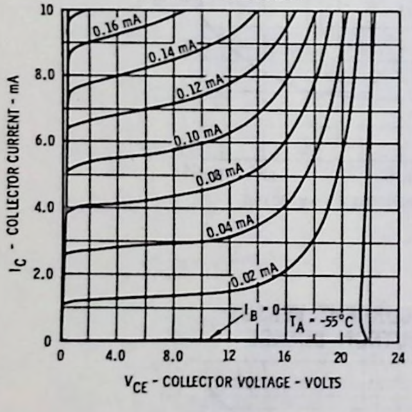
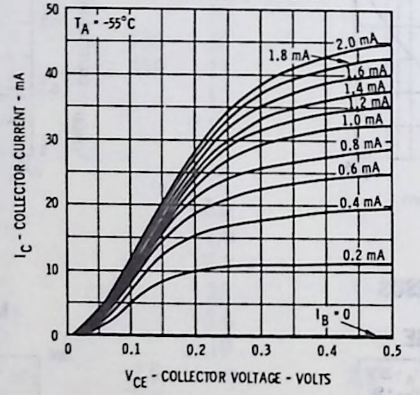
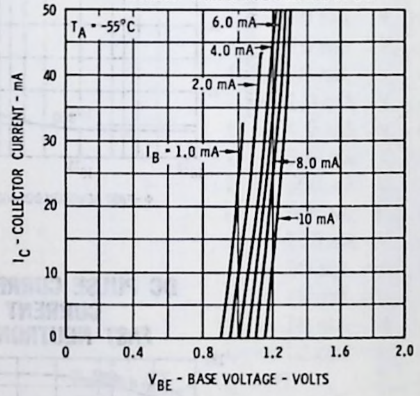


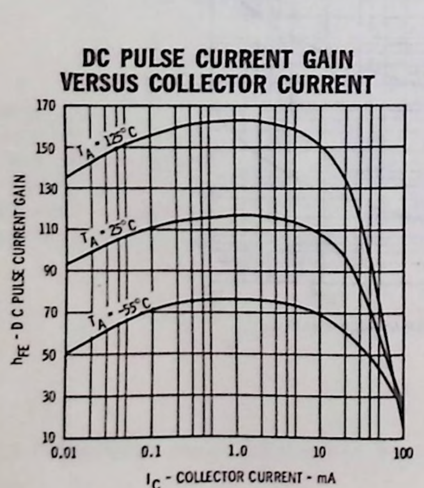
COLLECTOR CHARACTERISTICS° SATURATION REGION



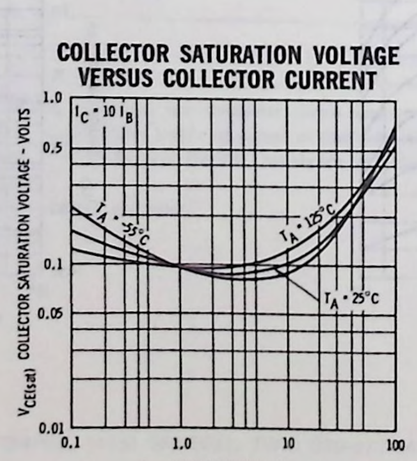
BASE CHARACTERISTICS°



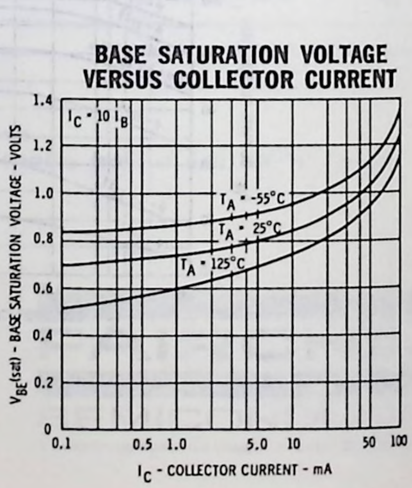
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

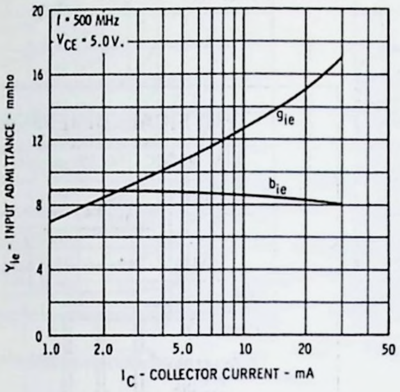


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

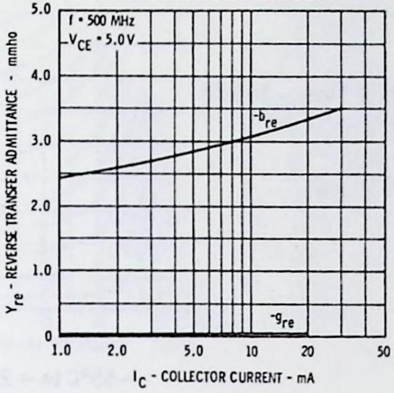


TYPICAL ELECTRICAL CHARACTERISTICS

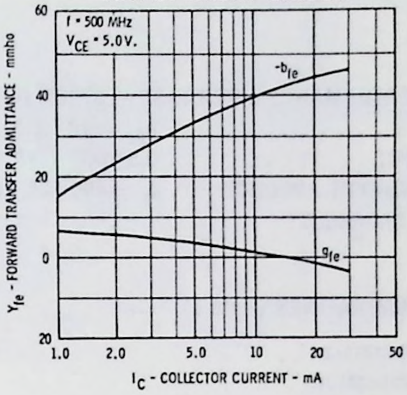
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



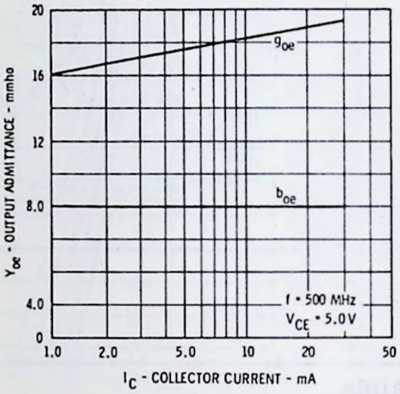
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



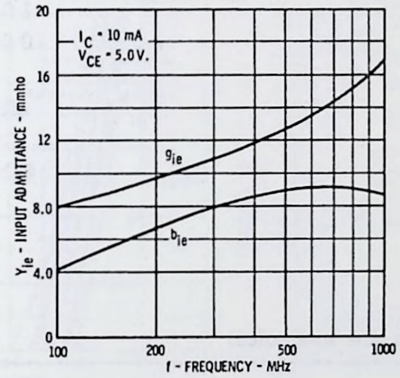
FOWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



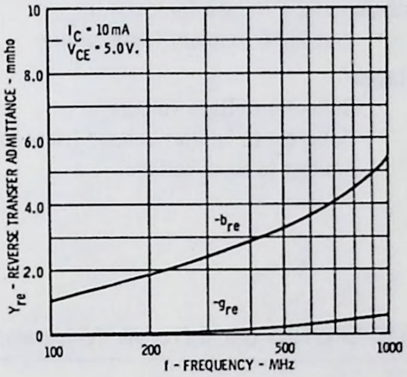
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



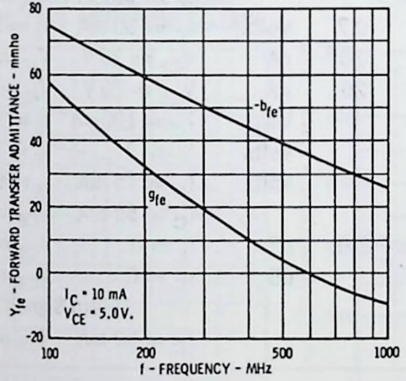
INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



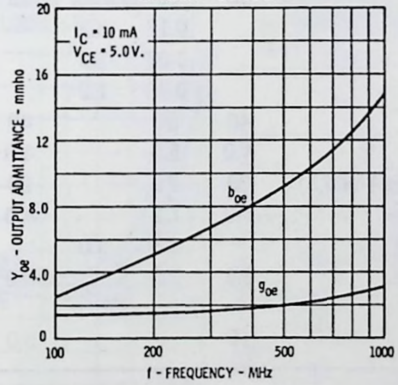
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



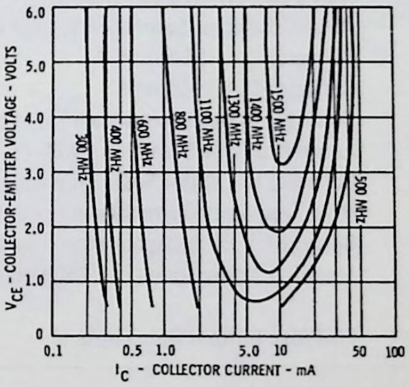
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



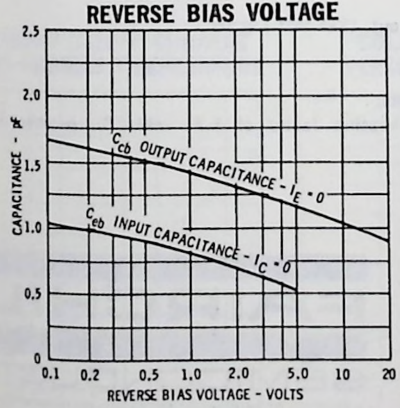
OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



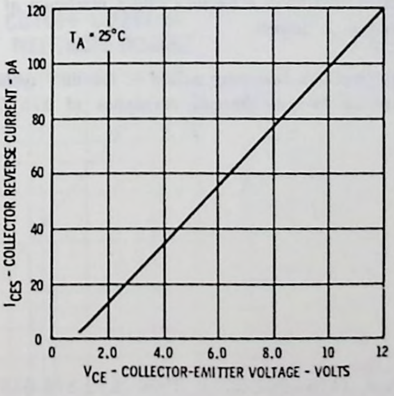
CONTOUR OF CONSTANT GAIN BANDWIDTH PRODUCT (f$_T$)



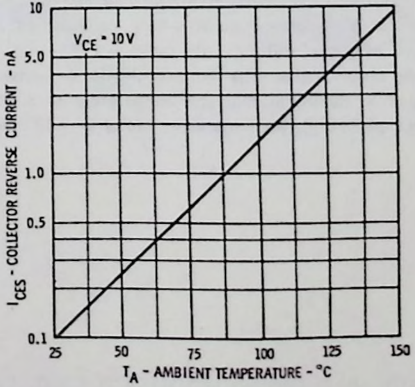
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



COLLECTOR-EMITTER REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



Fairchild cannot assume responsibility for use of any circuitry described. No circuit patent licenses are implied.

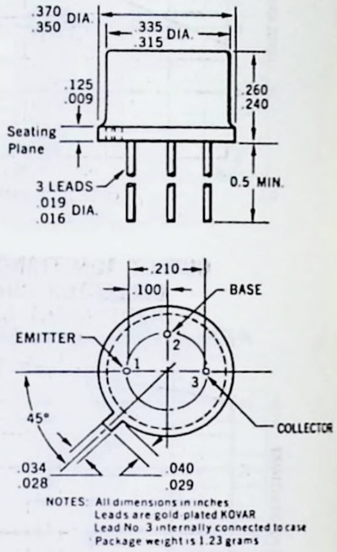
2N5236

RADIATION RESISTANT NPN CLASS-C RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE (3×10^{14} nvt > 10 keV)**
- **HIGH GAIN . . . . $h_{FE} = 10$ (MIN), 17 (TYP) AT 50 mA**
- **HIGH POWER OUT . . . . 0.5 WATT (TYP) AT 250 MHz**
- **HIGH GAIN BANDWITH PRODUCT . . . $f_T = 400$ MHz (MIN) AT 50 mA**
- **LARGE SIGNAL CAPABILITY**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		200°C
Lead Temperature (soldering, 60 second time limit)		300°C
Maximum Power Dissipation (Notes 6 and 7)		
Total Dissipation at 25°C Case Temperature		1.0 Watt
at 25°C Ambient Temperature		0.6 Watt
Maximum Voltages		
V_{CBO}	Collector to Base Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST-IRRADIATION (3×10^{14}nvt > 10 keV) MIN.	POST-IRRADIATION TYP.	POST-IRRADIATION MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	30	50	120	10	17			$I_C = 50$ mA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.12	0.2		0.3	0.7	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CES}	Collector Cutoff Current		0.03	1.0		0.7	20	nA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CES}(125°C)	Collector Cutoff Current		0.03	1.0		0.7	20	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40	50		40	50		Volts	$I_C = 100$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	5.5		4.0	5.5		Volts	$I_C = 0$	$I_E = 100$ μA
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	20	25		20	32		Volts	$I_C = 15$ mA	$I_B = 0$
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	5.0	7.5		4.0	6.5			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		2.3	3.0			3.0	pF	$I_E = 0$	$V_{CB} = 10$ V
G_{PE}	Amplifier Power Gain (f = 250 MHz)	6.0	7.0		5.0	6.5		dB	$I_C = 0$ (Zero Signal)	$V_{CE} = 20$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	15			5.0				$I_C = 50$ mA	$V_{CE} = 5.0$ V

*Planar is a patented Fairchild process.

NOTES:

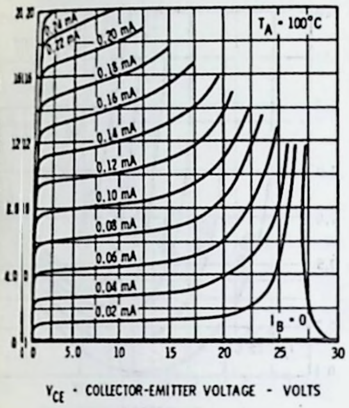
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) RF power-in = 100 mW (see test circuit).
(3) RF power-in = 100 mW. Conduction angle adjusted through R to obtain maximum efficiency with a minimum of 400 mW out. (See test circuit).
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(7) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C); junction to ambient thermal resistance of 292°C/Watt (derating factor of 3.42 mW/°C).

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

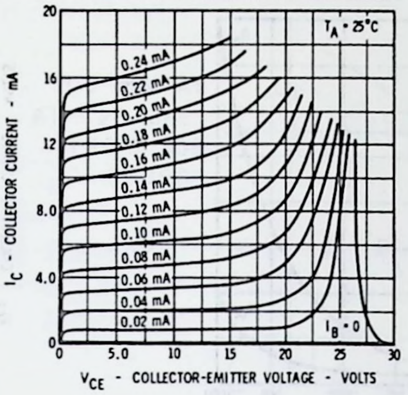
FAIRCHILD TRANSISTOR 2N5236

TYPICAL ELECTRICAL CHARACTERISTICS

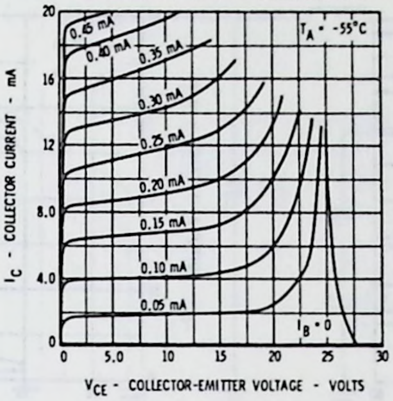
COLLECTOR CHARACTERISTICS



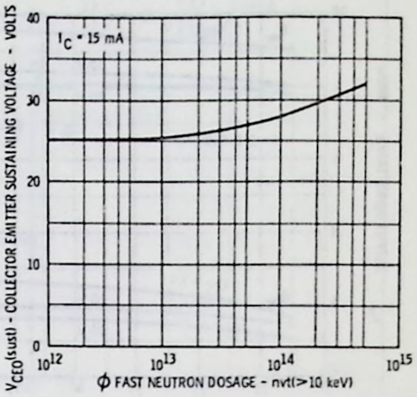
COLLECTOR CHARACTERISTICS



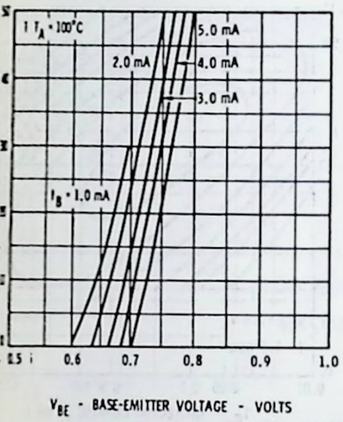
COLLECTOR CHARACTERISTICS



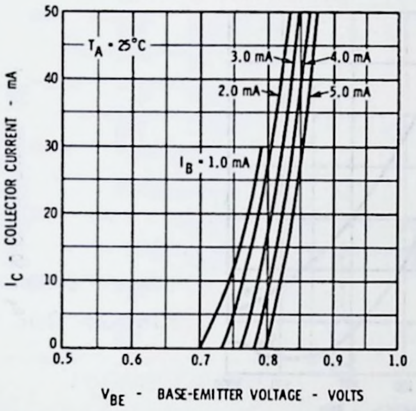
COLLECTOR EMITTER SUSTAINING VOLTAGE VERSUS FAST NEUTRON DOSAGE



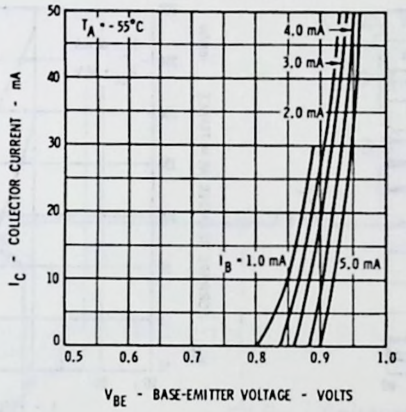
BASE CHARACTERISTICS



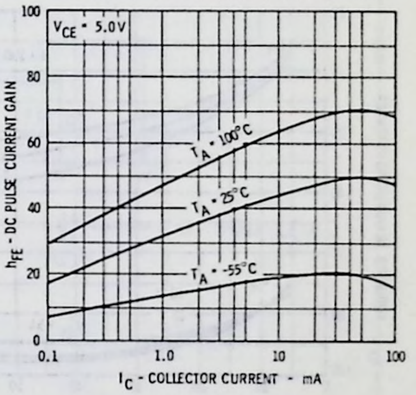
BASE CHARACTERISTICS



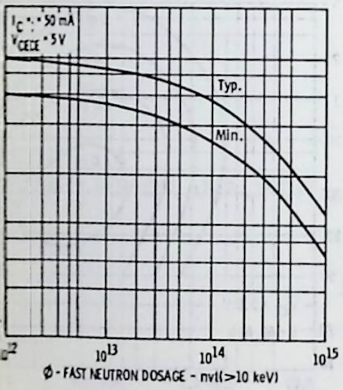
BASE CHARACTERISTICS



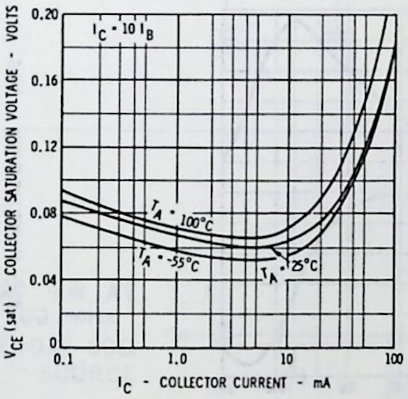
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



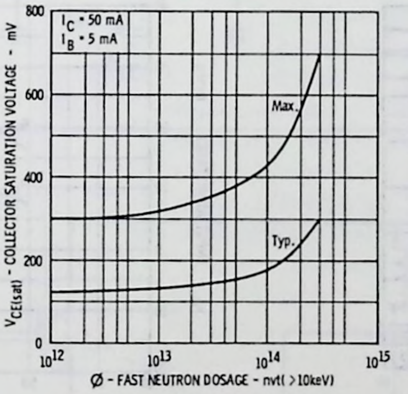
MINIMUM AND TYPICAL DC PULSE CURRENT GAIN VERSUS FAST NEUTRON DOSAGE



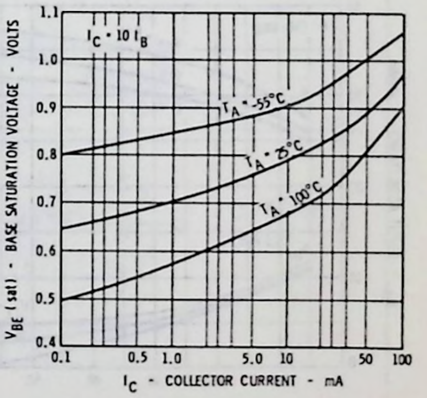
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



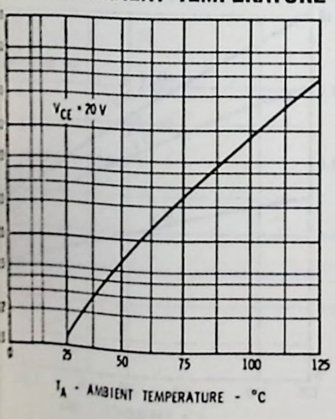
TYPICAL AND MAXIMUM COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE



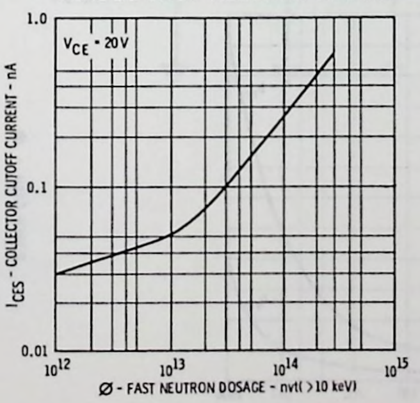
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



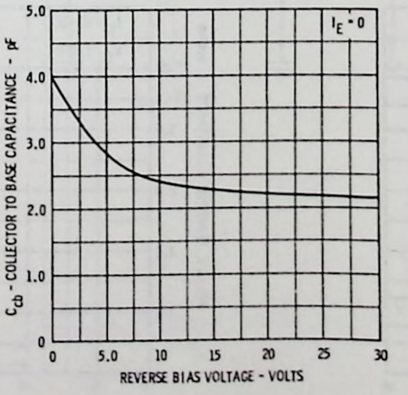
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



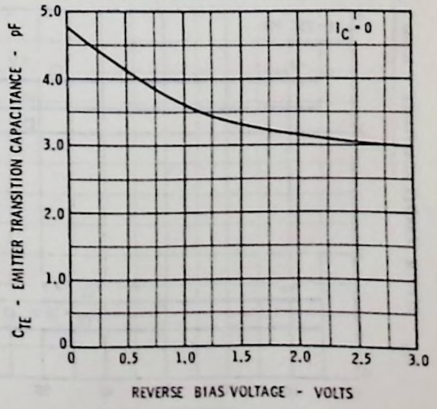
COLLECTOR CUTOFF CURRENT VERSUS FAST NEUTRON DOSAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



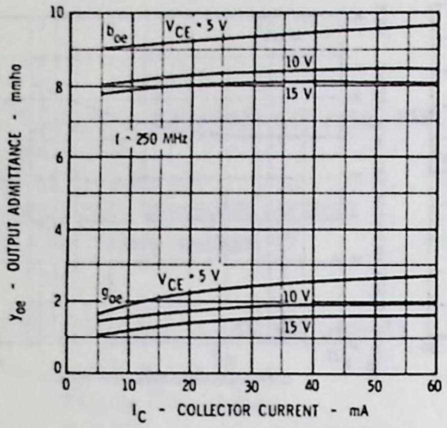
EMITTER TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



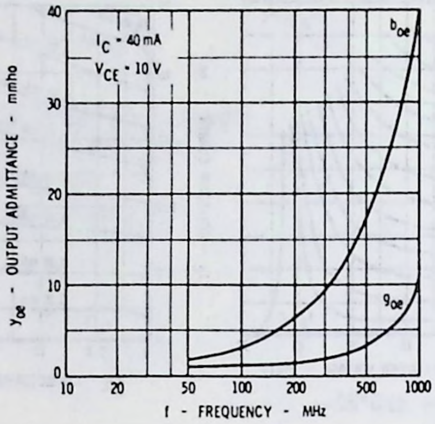
FAIRCHILD TRANSISTOR 2N5236

TYPICAL ELECTRICAL CHARACTERISTICS

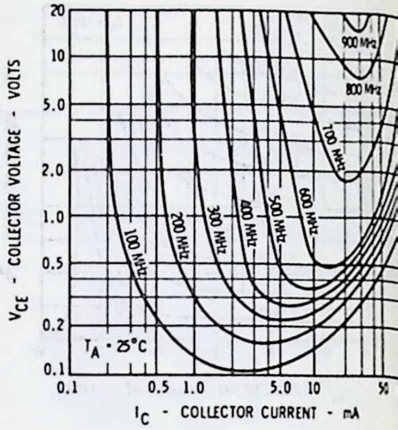
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT



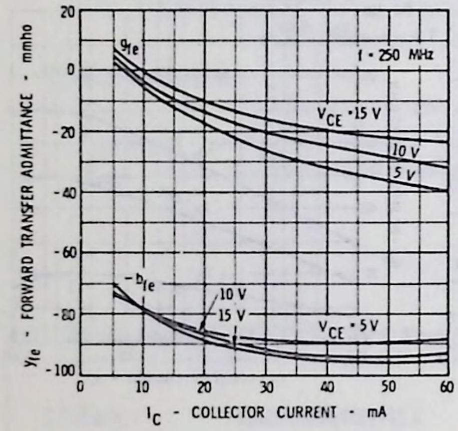
OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



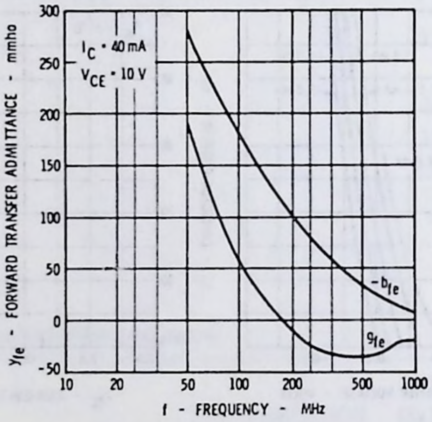
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



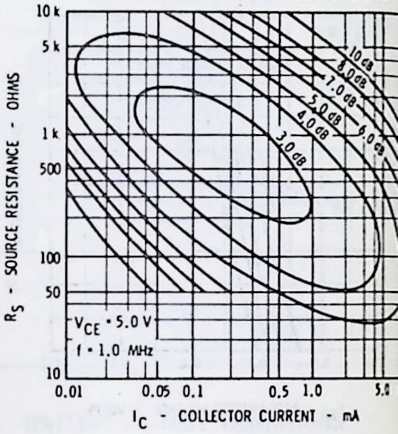
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



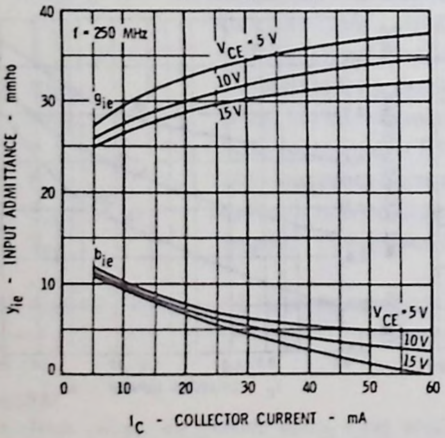
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



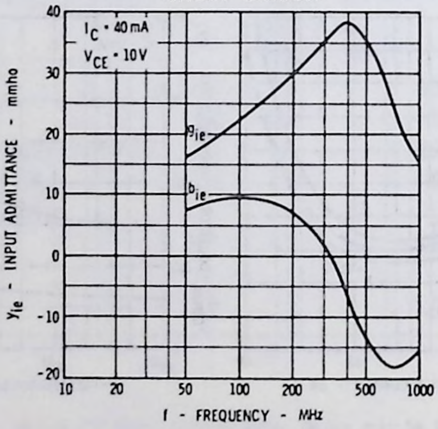
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



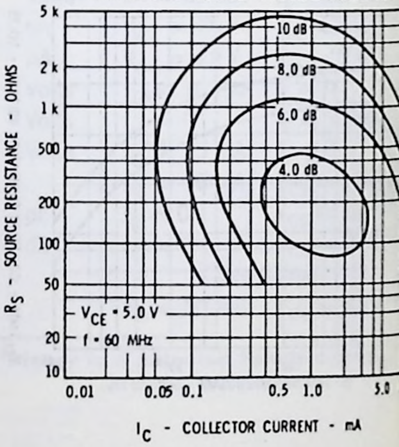
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



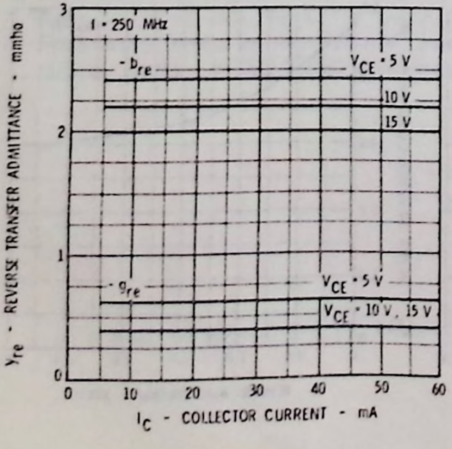
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



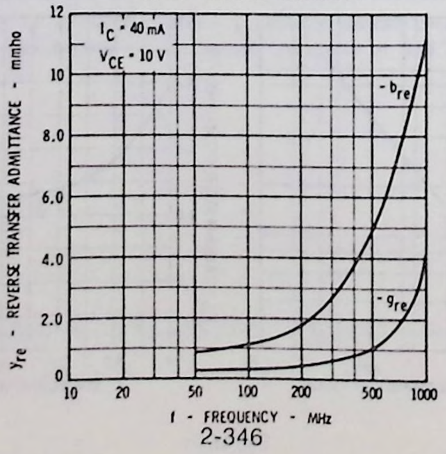
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



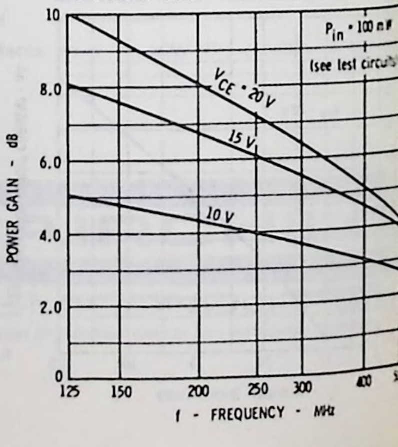
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT



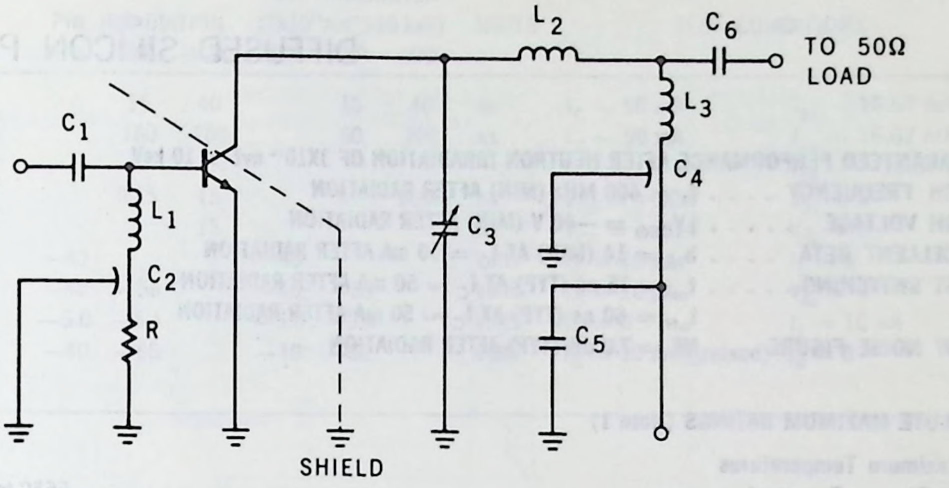
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



POWER GAIN VERSUS FREQUENCY

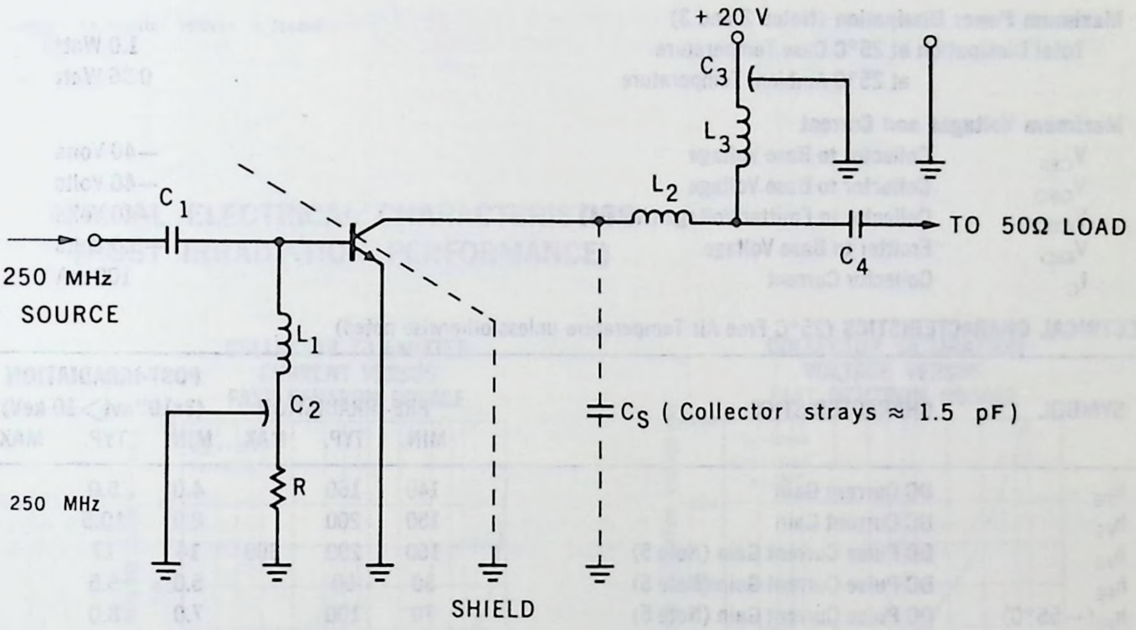


1225 MHz POWER AMPLIFIER


100 mW AT
AT 125 MHz
FROM 50Ω
SOURCE
C1
L1
C2
R
SHIELD
L2
C6
TO 50Ω
LOAD
L3
C4
C3
C5

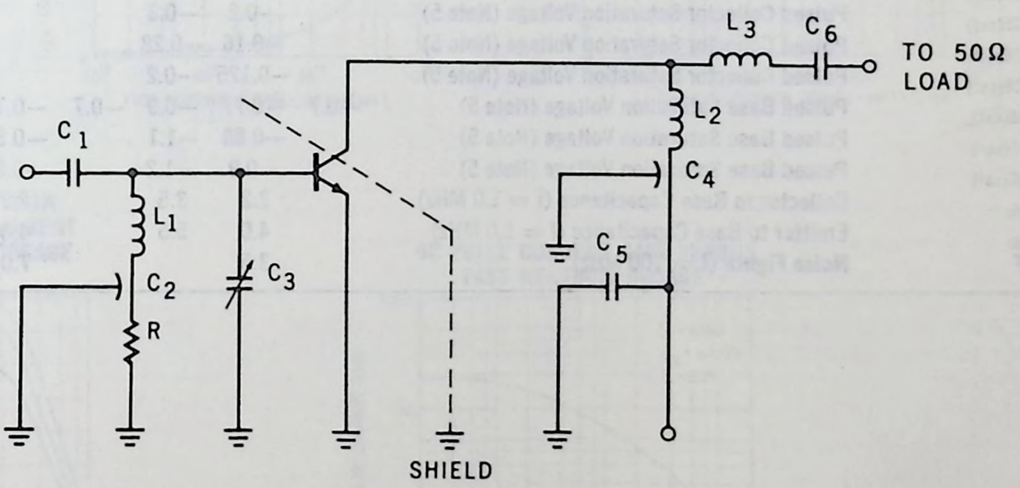
$C_1 \cdot C_2 \cdot C_4 \cdot C_6$ = 1000 pF BUTTON MICA
C_3 = 2 - 8 pF
C_5 = 6 μF AT 50 V
L_1 L_3 = RFC fr > 125 MHz
L_2 = - 16 pF
R = 200 Ω

2500 MHz POWER AMPLIFIER


+ 20 V
C3
L3
L2
C1
C4
TO 50Ω LOAD
100 mW AT 250 MHz
FROM 50Ω SOURCE
L1
C2
R
CS (Collector strays ≈ 1.5 pF)
SHIELD

C_{11} = 120 pF
$C_{12} \cdot C_3 \cdot C_4$ = 1000 pF BUTTON MICA
C_{SS} (COLLECTOR STRAYS) ≈ 1.5 pF
$L_{11} \cdot L_3$ = .47 μH (RF CHOKE) fr > 250 MHz
L_{22} = -5.5 pF
R = 200Ω

5000 MHz POWER AMPLIFER


100 mW AT
500 MHz
FROM 50Ω
SOURCE
C1
L1
C2
R
C3
SHIELD
L3
C6
TO 50Ω
LOAD
L2
C4
C5

C_1 = 10 pF
$C_2 \cdot C_4 \cdot C_6$ = 1000 pF BUTTON MICA
C_5 = 6 μF AT 50 V C_3 = 1 - 10 pF
L_1 = - 9 pF
L_2 = - 3.5 pF
L_3 = - 7.5 pF
R = 20Ω

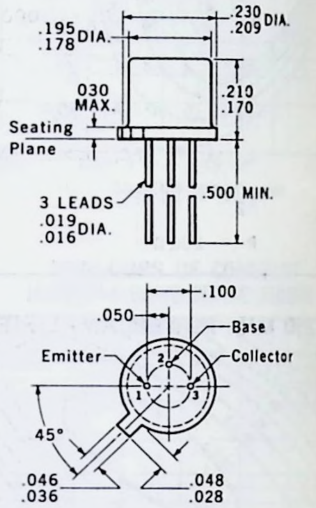
2N5244

PNP RADIATION RESISTANT HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **GUARANTEED PERFORMANCE AFTER NEUTRON IRRADIATION OF 3X10^{14} nvt > 10 keV**
- **HIGH FREQUENCY . . . . f_T = 400 MHz (MIN) AFTER RADIATION**
- **HIGH VOLTAGE . . . . . . LV_{CEO} = —40 V (MIN) AFTER RADIATION**
- **EXCELLENT BETA . . . . h_{FE} = 14 (MIN) AT I_C = 10 mA AFTER RADIATION**
- **FAST SWITCHING . . . . . t_{on} = 15 ns (TYP) AT $I_C \approx$ 50 mA AFTER RADIATION**
  t_{off} = 60 ns (TYP) AT $I_C \approx$ 50 mA AFTER RADIATION
- **LOW NOISE FIGURE . . . NF = 7.0 dB (TYP) AFTER RADIATION**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.44 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		200°C
Lead Temperature (Soldering, 60 second time limit)		300°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature		1.0 Watt
at 25°C Ambient Temperature		0.36 Watt
Maximum Voltages and Current		
V_{CES}	Collector to Base Voltage	−40 Volts
V_{CBO}	Collector to Base Voltage	−40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST-IRRADIATION (3x10^{14}nvt>10 keV) MIN.	POST-IRRADIATION (3x10^{14}nvt>10 keV) TYP.	POST-IRRADIATION (3x10^{14}nvt>10 keV) MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	140	160		4.0	6.0			I_C = 100 μA	V_{CE} = −5.0 V
h_{FE}	DC Current Gain	150	200		8.0	10.5			I_C = 1.0 mA	V_{CE} = −1.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	150	200	300	**14**	**17**			**I_C = 10 mA**	**V_{CE} = −1.0 V**
h_{FE}	DC Pulse Current Gain (Note 5)	30	60		5.0	6.5			I_C = 50 mA	V_{CE} = −1.0 V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	70	100		7.0	8.0			I_C = 10 mA	V_{CE} = −1.0 V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	4.5	6.0		**4.0**	**5.5**			**I_C = 10 mA**	**V_{CE} = −20 V**
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.1	−0.14		−0.32	−0.55	Volts	I_C = 10 mA	I_B = 1.0 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.2	−0.3				Volts	I_C = 50 mA	I_B = 5.0 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.16	−0.28			−1.0	Volts	I_C = 50 mA	I_B = 10 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.125	−0.2				Volts	I_C = 50 mA	I_B = 16.67 mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)	−0.7	−0.77	−0.9	−0.7	−0.75	−0.9	Volts	I_C = 10 mA	I_B = 1.0 mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−0.88	−1.1		−0.84	−1.1	Volts	I_C = 50 mA	I_B = 5.0 mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−0.9	−1.2		−0.88	−1.2	Volts	I_C = 50 mA	I_B = 16.67 mA
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		2.2	3.5		2.2	3.5	pF	I_E = 0	V_{CB} = −10 V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		4.0	5.5		4.0	5.5	pF	I_C = 0	V_{EB} = −0.5 V
NF	**Noise Figure** (f = 100 MHz)		3.5			**7.0**		**dB**	**I_C = 1.0 mA**	**V_{CE} = −5.0 V**

*Planar is a patented Fairchild proces

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTOR 2N5244

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	PRE-IRRADIATION			POST-IRRADIATION (3×10^{14}nvt > 10 keV)			UNITS	TEST CONDITIONS	
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
t_{on}	**Turn On Time (Note 6)**		15	40		15	40	ns	$I_C \approx 50$ mA	$I_{B1} \approx 16.67$ mA
t_{off}	**Turn Off Time (Note 6)**		160	200		60	200	ns	$I_C \approx 50$ mA	$I_{B1} \approx 16.67$ mA $I_{B2} \approx -16.67$ mA
I_{CES}	Collector Reverse Current		0.15	15		3.3	1000	nA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CES}(125°C)	Collector Reverse Current			15				µA	$V_{CE} = -30$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−40			−40			Volts	$I_C = 10$ µA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−40	−56		−40	−58		Volts	$I_C = 10$ µA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0	−5.4		−5.0	−5.4		Volts	$I_C = 0$	$I_E = 10$ µA
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	−40	−56		**−40**	**−62**		**Volts**	**$I_C = 10$ mA (pulsed)**	**$I_B = 0$**

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.06 mW/°C).

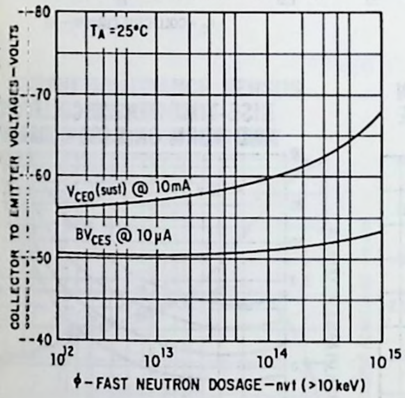
This rating refers to a high current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 µs; duty cycle = 1%.

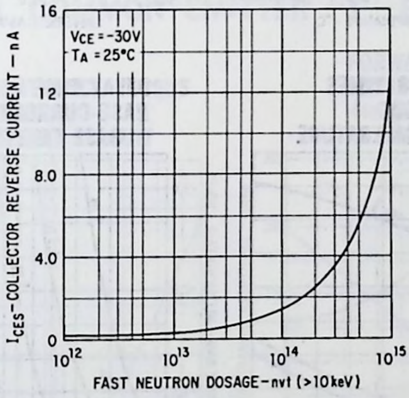
See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

TYPICAL ELECTRICAL CHARACTERISTICS (POST IRRADIATION PERFORMANCE)

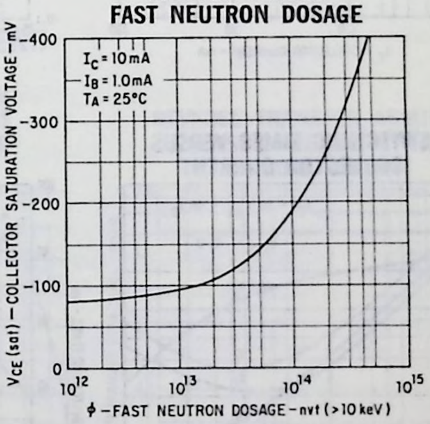
COLLECTOR TO EMITTER VOLTAGES VERSUS FAST NEUTRON DOSAGE



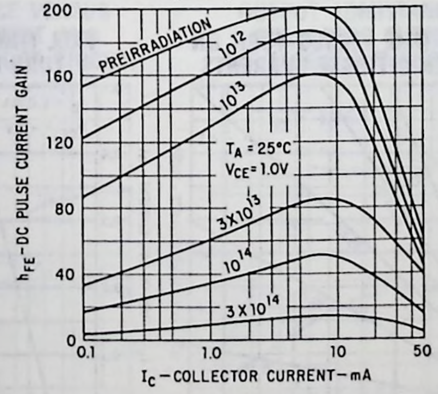
COLLECTOR TO EMITTER CURRENT VERSUS FAST NEUTRON DOSAGE



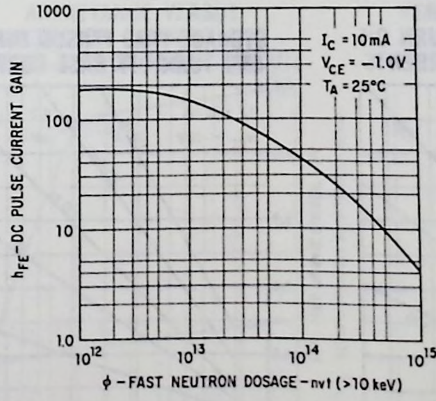
COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT AND FAST NEUTRON DOSAGE (nvt > 10 keV)

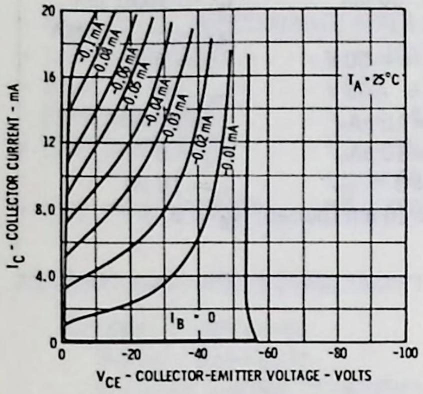


DC PULSE CURRENT GAIN VERSUS FAST NEUTRON DOSAGE

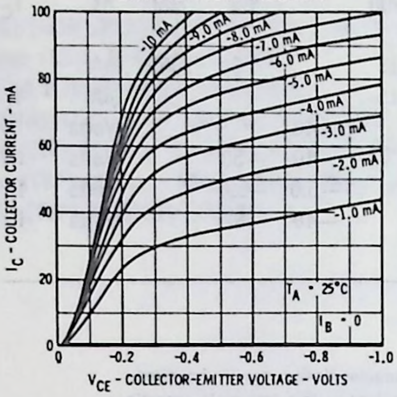


TYPICAL ELECTRICAL CHARACTERISTICS

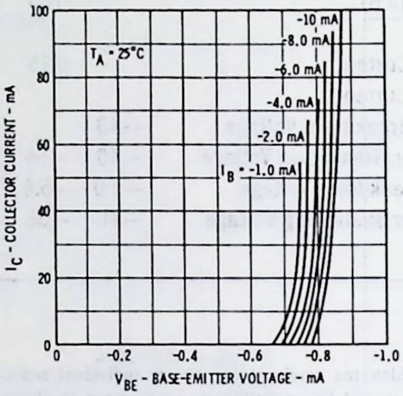
COLLECTOR CHARACTERISTICS
ACTIVE REGION



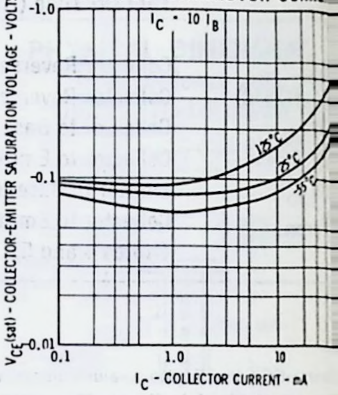
COLLECTOR CHARACTERISTICS
SATURATION REGION



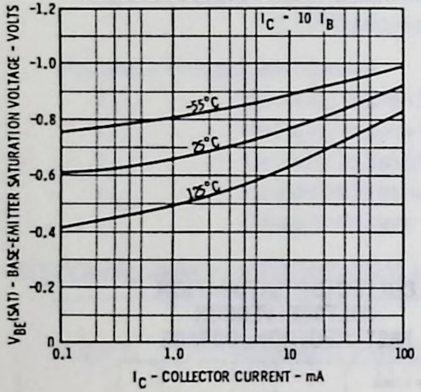
BASE CHARACTERISTICS



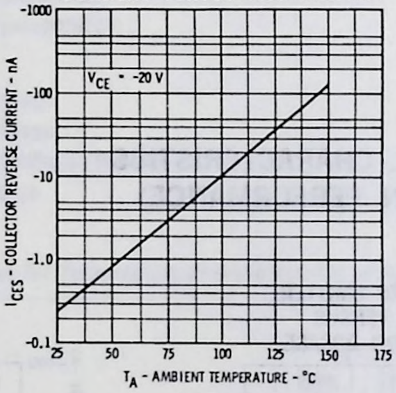
COLLECTOR SATURATION VOLT
VERSUS COLLECTOR CURRE



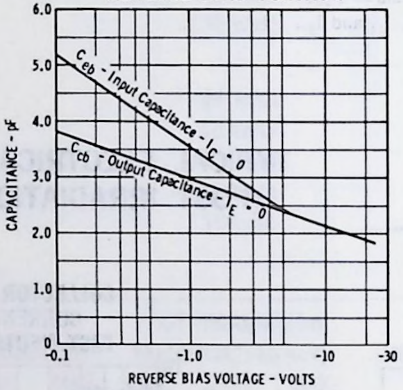
BASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



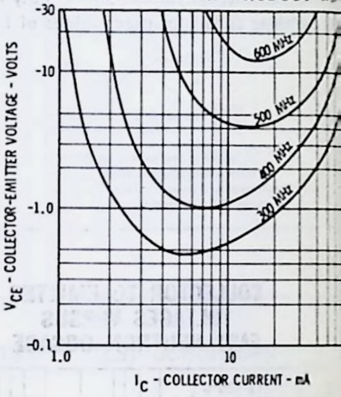
COLLECTOR-BASE DIODE REVERSE
CURRENT VERSUS TEMPERATURE



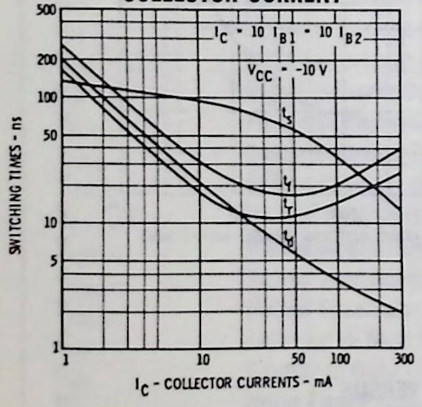
INPUT AND OUTPUT
CAPACITANCE VERSUS
REVERSE BIAS VOLTAGE



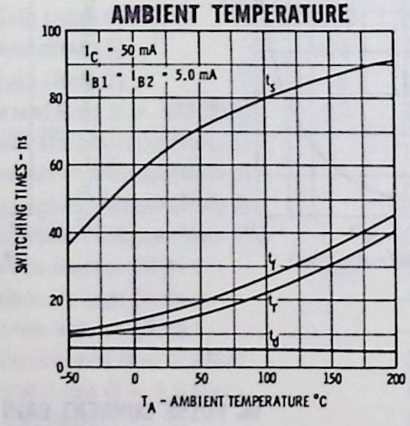
CONTOURS OF CONSTANT
BANDWIDTH PRODUCT (f



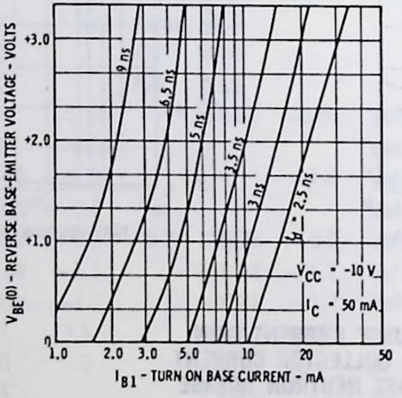
SWITCHING TIMES VERSUS
COLLECTOR CURRENT



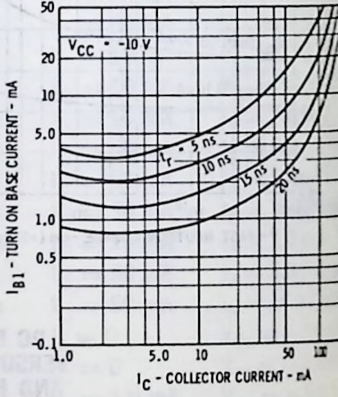
SWITCHING TIMES
VERSUS
AMBIENT TEMPERATURE



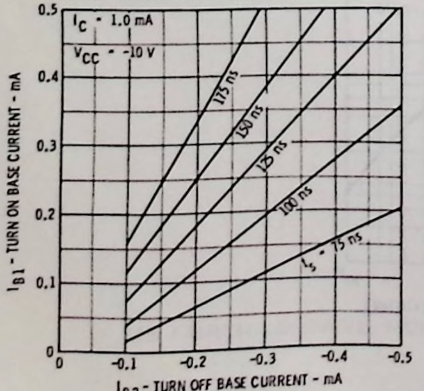
DELAY TIME VERSUS TURN ON
BASE CURRENT AND REVERSE
BASE EMITTER VOLTAGE



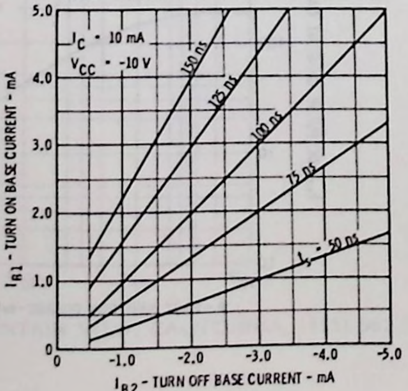
RISE TIME VERSUS COLLECT
AND TURN ON BASE CURREN



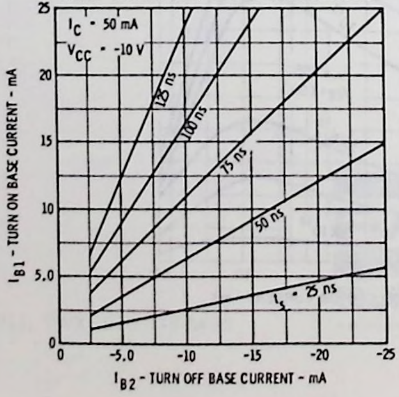
STORAGE TIME VERSUS TURN ON
AND TURN OFF BASE CURRENTS



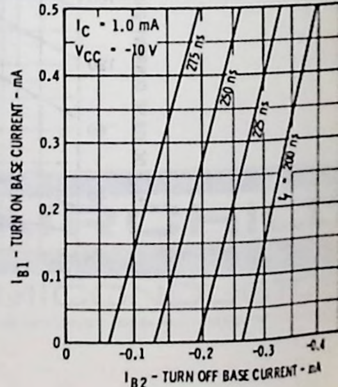
STORAGE TIME VERSUS TURN ON
AND TURN OFF BASE CURRENTS



STORAGE TIME VERSUS TURN ON
AND TURN OFF BASE CURRENTS

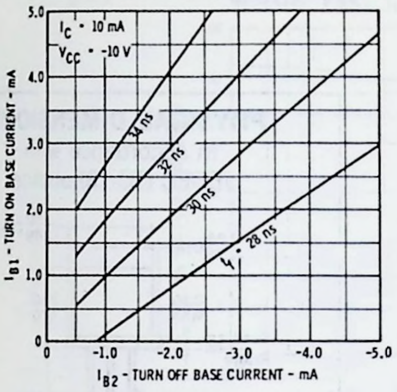


FALL TIME VERSUS TURN ON A
TURN OFF BASE CURRENTS

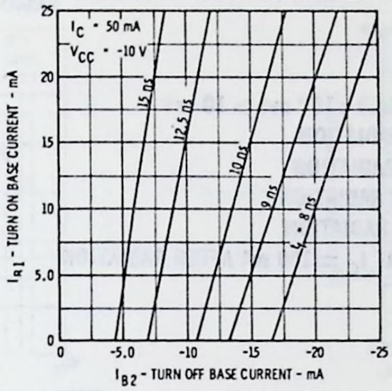


TYPICAL ELECTRICAL CHARACTERISTICS

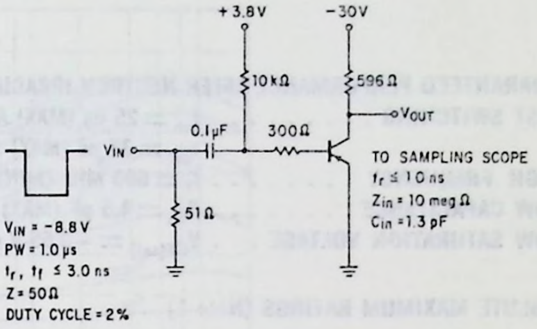
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



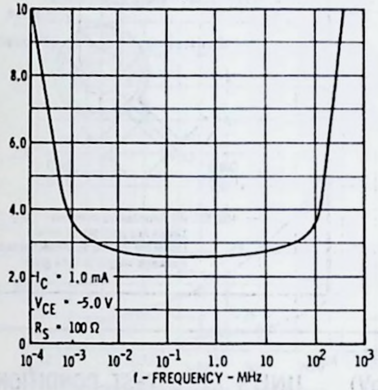
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



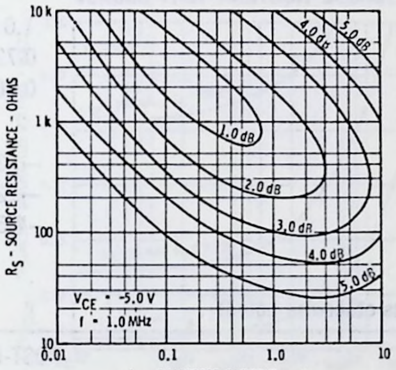
SWITCHING TIME TEST CIRCUIT


+3.8V
-30V
10 kΩ
596 Ω
V_OUT
0.1 µF
300 Ω
V_IN
51 Ω
TO SAMPLING SCOPE
t_r ≤ 1.0 ns
Z_in = 10 meg Ω
C_in = 1.3 pF
V_IN = -8.8 V
PW = 1.0 µs
t_r, t_f ≤ 3.0 ns
Z = 50 Ω
DUTY CYCLE = 2%

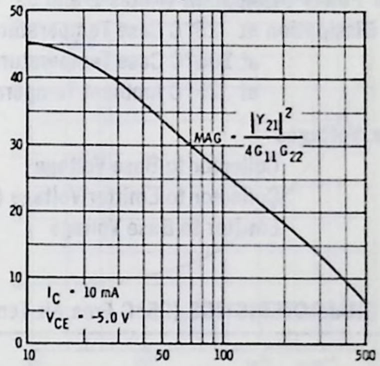
NOISE FIGURE VERSUS FREQUENCY



NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT

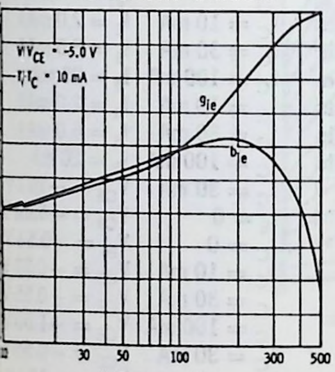


POWER GAIN VERSUS FREQUENCY

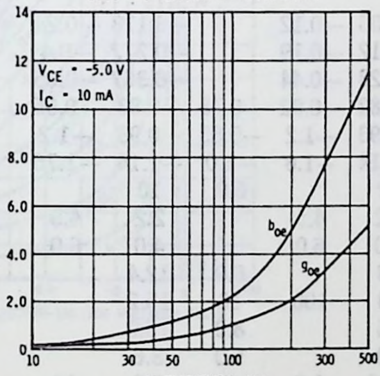


TYPICAL COMMON EMITTER "Y" PARAMETERS

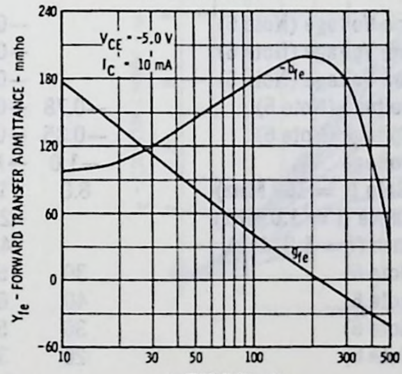
INPUT ADMITTANCE VERSUS FREQUENCY— OUTPUT SHORT CIRCUIT



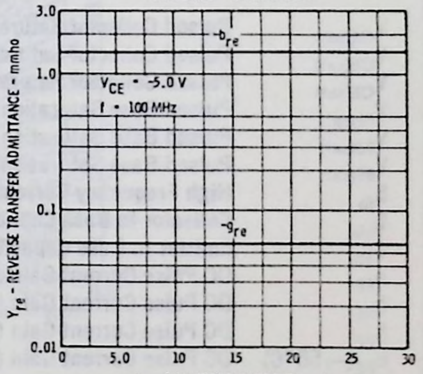
OUTPUT ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



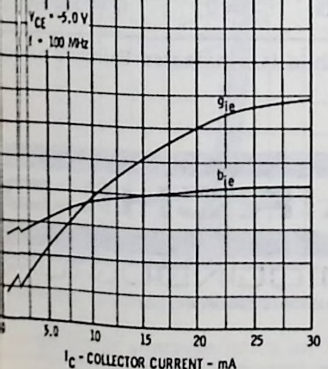
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



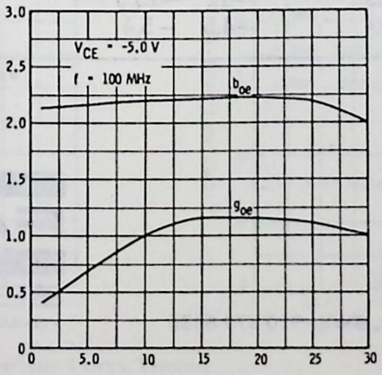
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



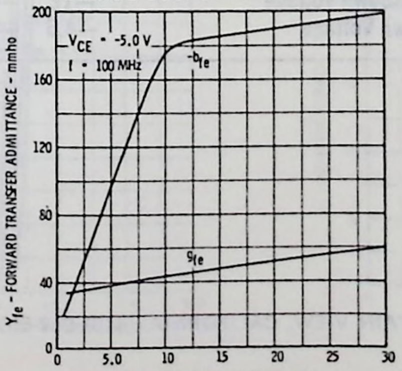
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



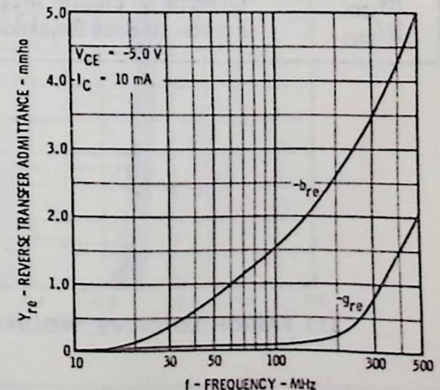
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



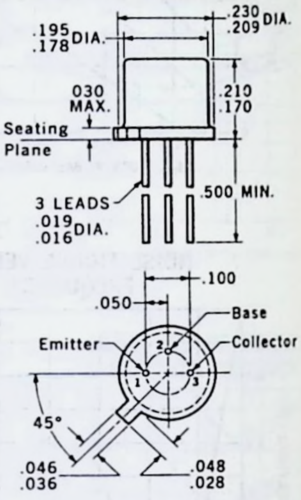
2N5292

RADIATION RESISTANT, PNP HIGH SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTOR

- **GUARANTEED PERFORMANCE AFTER NEUTRON IRRADIATION OF 3 x 10^{14} nvt > 10 keV**
- **FAST SWITCHING . . . . $t_{on} = 25$ ns (MAX) AFTER RADIATION**
  $t_{off} = 35$ ns (MAX) AFTER RADIATION
- **HIGH FREQUENCY . . . . $f_T = 600$ MHz (MIN) AFTER RADIATION**
- **LOW CAPACITANCE . . . . $C_{cb} = 4.5$ pF (MAX) AFTER RADIATION**
- **LOW SATURATION VOLTAGE . . . $V_{CE(sat)} = -0.65$ V (MAX) AT $I_C = 100$ mA AFTER RADIATION**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.44 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C
Lead Temperature (Soldering, 60 second time limit)	300°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 Watts
at 100°C Case Temperature	0.72 Watt
at 25°C Ambient Temperature	0.36 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	−12 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−12 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

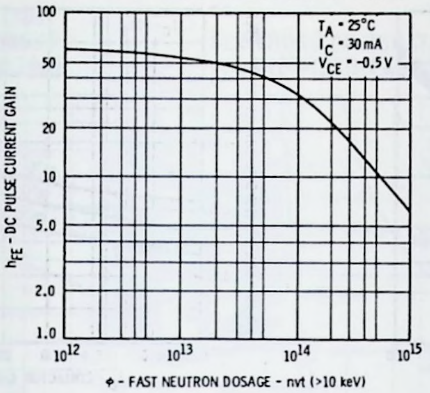
SYMBOL	CHARACTERISTICS	PRE-IRRADIATION MIN.	PRE-IRRADIATION TYP.	PRE-IRRADIATION MAX.	POST-IRRADIATION (3x10^{14} nvt > 10 keV) MIN.	POST-IRRADIATION TYP.	POST-IRRADIATION MAX.	UNITS	TEST CONDITIONS	
t_{on}	**Turn On Time** (Note 5, Figure 1)		6.0	15		**8.0**	**25**	ns	$I_C \approx 30$ mA	$I_{B1} \approx 6.0$ mA
t_{off}	**Turn Off Time** (Note 5, Figure 1)		18	35		**15**	**35**	ns	$I_C \approx 30$ mA	$I_{B1} \approx 6.0$ mA $I_{B2} \approx -6.0$ mA
τ_s	Charge Storage Time Constant (Note 6, Figure 2)		15	20		5.0	20	ns	$I_C \approx 10$ mA	$I_{B1} \approx 10$ mA $I_{B2} \approx -10$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 6)		−0.06	−0.12		−0.113	−0.24	Volts	$I_C = 10$ mA	$I_B = 2.0$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 6)		−0.12	−0.19		−0.212	−0.4	Volts	$I_C = 30$ mA	$I_B = 6.0$ mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 6)		−0.28	−0.44		**−0.367**	**−0.65**	**Volts**	$I_C = 100$ mA	$I_B = 20$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)	−0.78	−0.82	−0.92	−0.78	−0.83	−0.95	Volts	$I_C = 10$ mA	$I_B = 2.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)	−0.85	−0.93	−1.2	−0.85	−0.93	−1.2	Volts	$I_C = 30$ mA	$I_B = 6.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage	−1.0	−1.14	−1.6	−1.0	−1.14	−1.75	Volts	$I_C = 100$ mA	$I_B = 20$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	8.0	12		**6.0**	**10**			$I_C = 30$ mA	$V_{CE} = -10$ V
C_{cb}	**Collector to Base Capacitance (f = 1.0 MHz)**		2.2	4.5		**2.2**	**4.5**	**pF**	$I_E = 0$	$V_{CB} = -5.0$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		4.0	6.0		4.0	6.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
h_{FE}	DC Pulse Current Gain (Note 6)	30	53		6.0	12.4			$I_C = 10$ mA	$V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain (Note 6)	40	63	100	10	15.2			$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain (Note 6)	30	55		8.0	13.9			$I_C = 100$ mA	$V_{CE} = -1.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 6)	20	38		5.0	8.6			$I_C = 30$ mA	$V_{CE} = -0.5$ V
I_{CES}	Collector Reverse Current		0.05	1.0		0.3	10	nA	$V_{BE} = 0$	$V_{CE} = -10$ V
$I_{CES}(125°C)$	Collector Reverse Current		0.01	10		0.5	20	μA	$V_{BE} = 0$	$V_{CE} = -10$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 6)	−12	−16		−12	−17.7		Volts	$I_C = 10$ mA	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−12	−24		−12	−24.3		Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−12	−23		−12	−23.3		Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5	−5.4		−4.5	−5.4		Volts	$I_C = 0$	$I_E = 100$ μA

*Fairchild is a patented Fairchild process

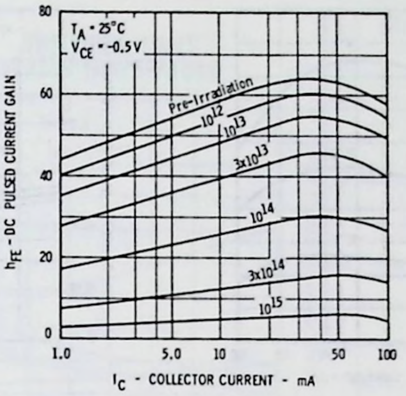
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

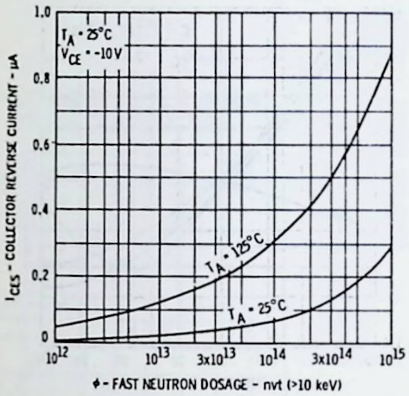
DC PULSE CURRENT GAIN VERSUS FAST NEUTRON DOSAGE



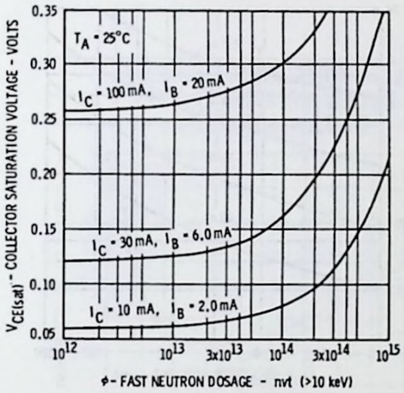
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT FAST NEUTRON DOSAGE



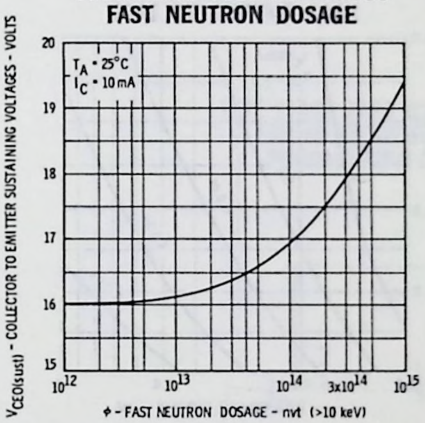
COLLECTOR TO EMITTER CURRENT VERSUS FAST NEUTRON DOSAGE



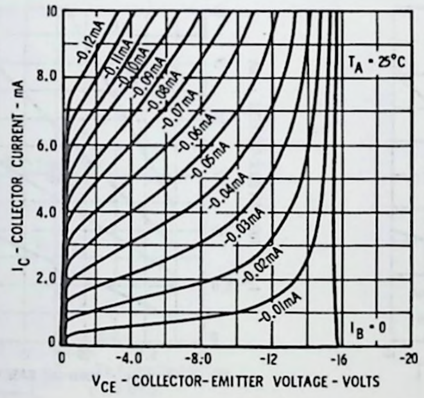
COLLECTOR SATURATION VOLTAGE VERSUS FAST NEUTRON DOSAGE



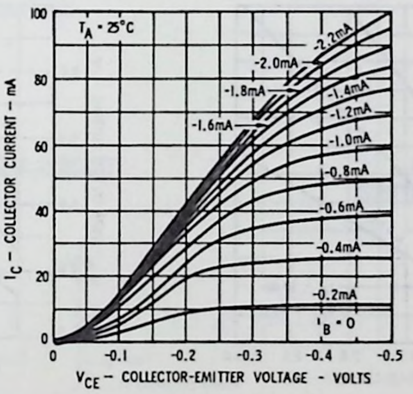
COLLECTOR TO EMITTER SUSTAINING VOLTAGE VERSUS FAST NEUTRON DOSAGE



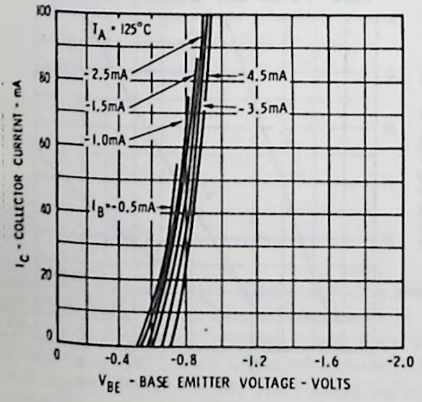
COLLECTOR CHARACTERISTICS*



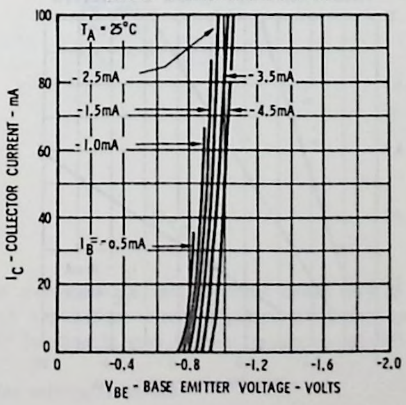
COLLECTOR CHARACTERISTICS*



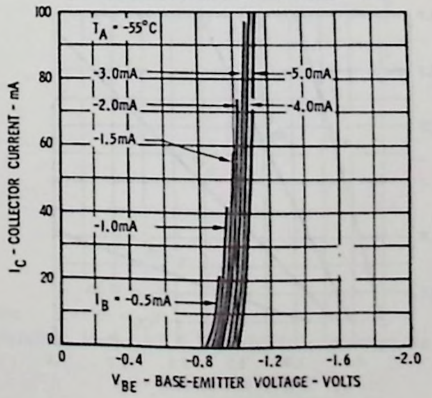
BASE CHARACTERISTIC*



BASE CHARACTERISTIC*



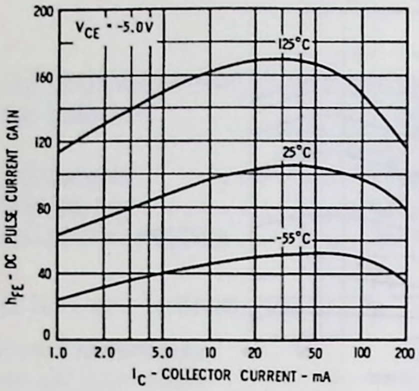
BASE CHARACTERISTIC*



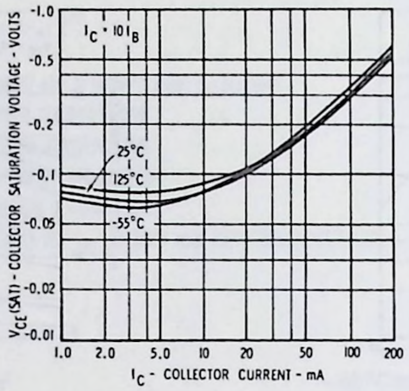
ngle family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

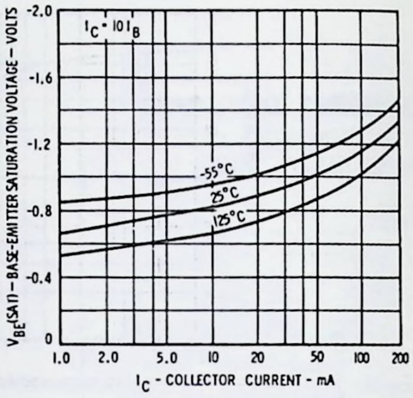
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



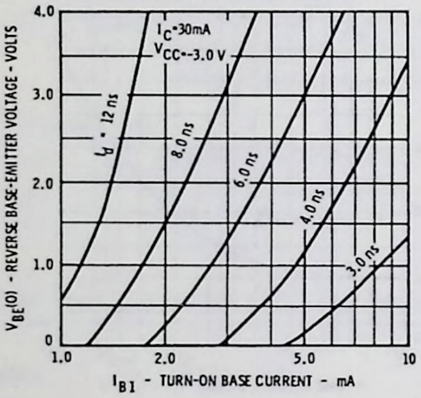
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



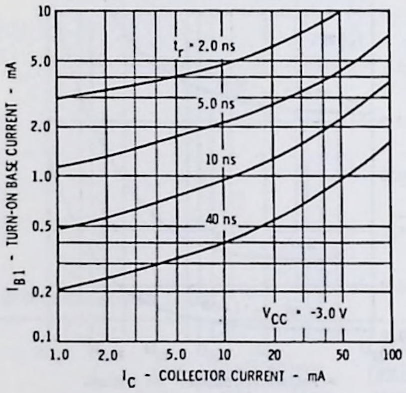
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



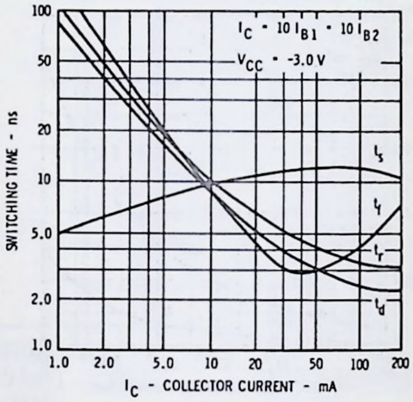
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



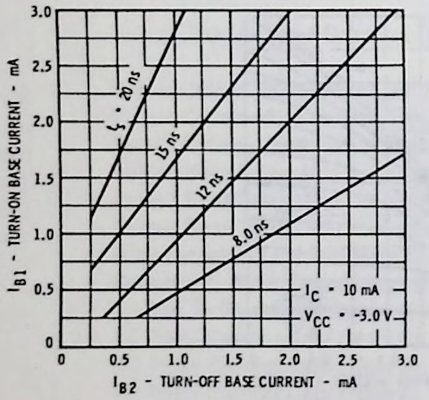
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



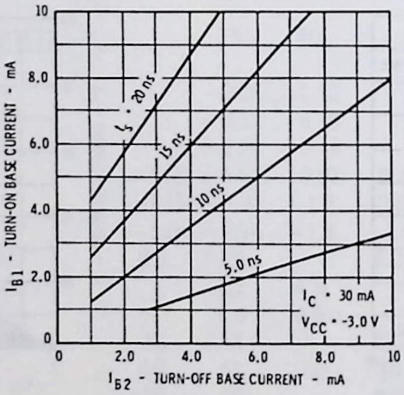
SWITCHING TIMES VERSUS COLLECTOR CURRENT



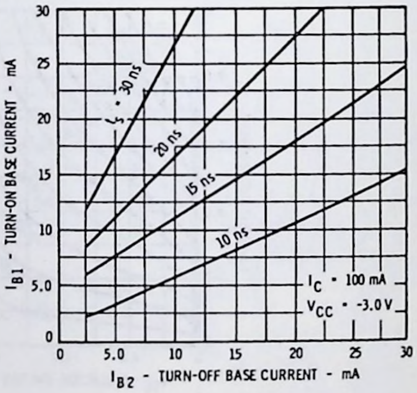
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



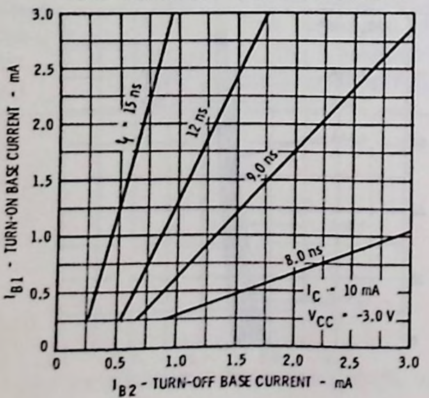
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



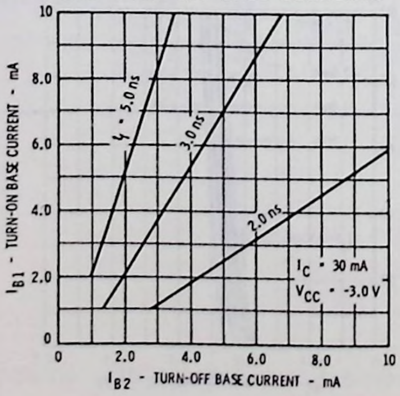
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



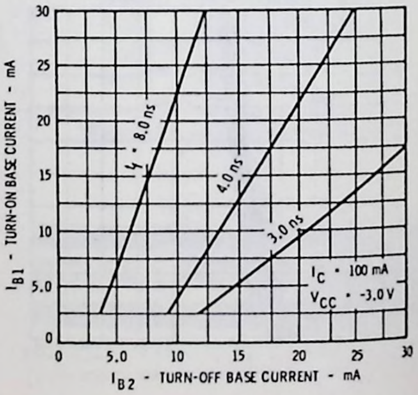
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

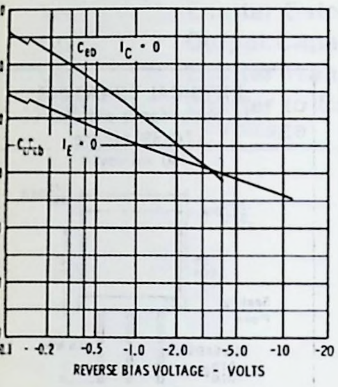


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

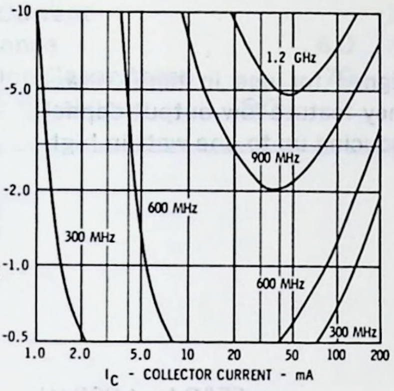


TYPICAL ELECTRICAL CHARACTERISTICS

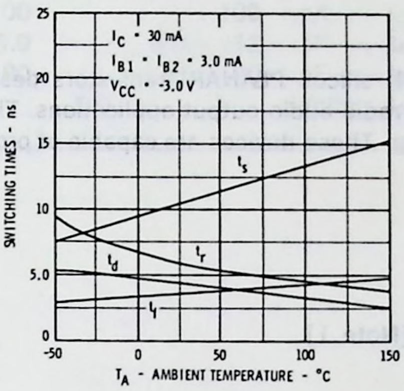
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



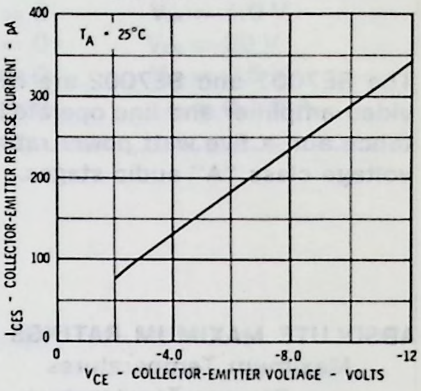
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



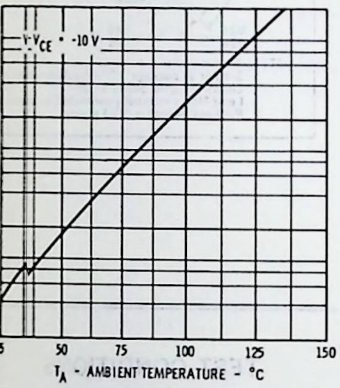
SWITCHING TIMES VERSUS TEMPERATURE



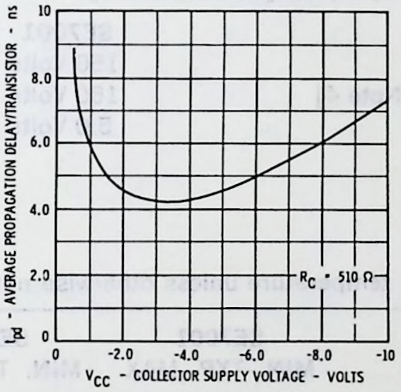
COLLECTOR-EMITTER REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



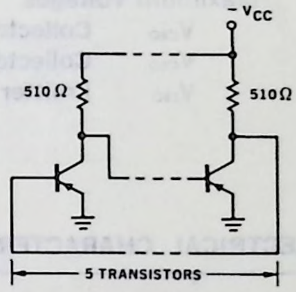
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

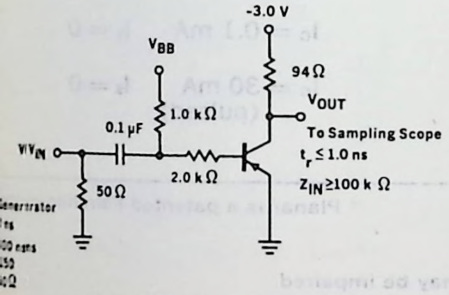


FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY


-V_CC
510 Ω
510 Ω
5 TRANSISTORS

$$tpd = \frac{1}{10\ fosc.}$$

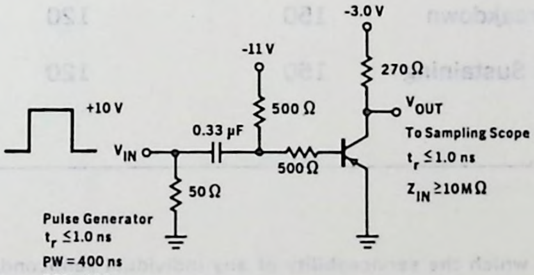
SWITCHING TIME TEST CIRCUIT FIGURE 1


-3.0 V
V_BB
94 Ω
V_OUT
1.0 kΩ
0.1 µF
To Sampling Scope
t_r ≤ 1.0 ns
Z_IN ≥ 100 k Ω
V_IN
2.0 kΩ
50 Ω
Generator

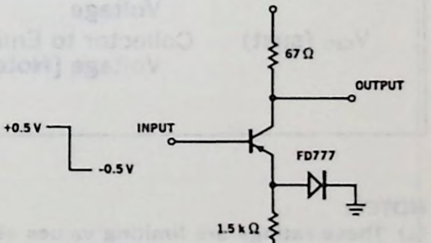
t_{on} $V_{BB} = 0, V_{IN} = -12.8\ V$

t_{off} $V_{BB} = -18.8\ V, V_{IN} = +23.5V$

STORAGE TIME TEST CIRCUIT FIGURE 2


-3.0 V
-11 V
270 Ω
+10 V
500 Ω
V_OUT
0.33 µF
To Sampling Scope
V_IN
500 Ω
t_r ≤ 1.0 ns
Z_IN ≥ 10MΩ
50 Ω
Pulse Generator
t_r ≤ 1.0 ns
PW = 400 ns
PPS = 150
Z_IN = 50 Ω

NON SATURATED SWITCHING PERFORMANCE


-3.0 V
67 Ω
OUTPUT
+0.5 V
INPUT
-0.5 V
FD777
1.5 kΩ
+25 V

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C); junction to ambient thermal resistance of 486°C/Watt (derating factor of 2.06 mW/°C).

This rating refers to a high current point where collector to emitter voltage is lowest.

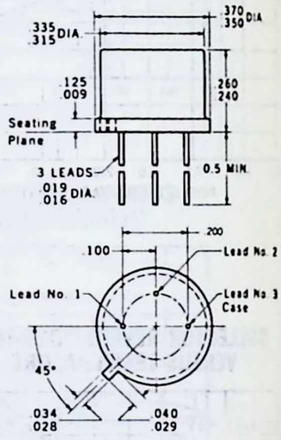
See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

Pulse Conditions: length = 300 µs; duty cycle = 1%.

SE7001 · SE7002
NPN HIGH-VOLTAGE AUDIO / VIDEO AMPLIFIERS
DIFFUSED SILICON PLANAR* TRANSISTORS

The SE7001 and SE7002 are NPN silicon PLANAR transistors designed for use in high-voltage video amplifier and line operated radio audio output applications. They feature low output capacitance and a five watt power rating. These devices are capable of producing up to one watt in high-voltage class "A" audio stages.

PHYSICAL DIMENSIONS
in accordance with JEDEC
(TO-39) outline
(50 mil kovar)



NOTES: All dimensions in inches
Similar to package "C" except for lead le
Leads are gold-plated kovar
Lead No. 3 internally connected to case
Package weight is 1.23 grams

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures		
Storage Temperature	−65°C to +200°C	
Operating Junction Temperature	200°C Maximum	
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum	
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	5.0 Watts	
at 25°C Free Air Temperature [Notes 2 and 3]	0.8 Watt	
Maximum Voltages	**SE7001**	**SE7002**
V_{CBO} Collector to Base Voltage	150 Volts	120 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	150 Volts	120 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	SE7001 MIN.	SE7001 TYP.	SE7001 MAX.	SE7002 MIN.	SE7002 TYP.	SE7002 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	60		30	60			$I_C = 30$ mA	$V_{CE} = 10$ V
V_{BE} (sat)	Base Saturation Voltage		0.8	0.9		0.8	0.9	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.33	2.0		0.33	2.0	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	25	50		25	50			$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0	3.0		2.0	3.0			$I_C = 30$ mA	$V_{CE} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	150			120				$I_C = 0.1$ mA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 4]	150			120				$I_C = 30$ mA (pulsed)	$I_B = 0$

* Planar is a patented Fairchild proc

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/watt (derating factor of 28.6 mW/°C); junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.56 mW/°C).
(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	SE7001			SE7002			UNITS	TEST CONDITIONS	
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
h_{FE}	DC Pulse Current Gain [Note 5]	25	60		25	60			$I_C = 10$ mA	$V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current		0.3	100		0.3	100	nA	$I_E = 0$	$V_{CB} = 75$ V
I_{CBO} (150°C)	Collector Cutoff Current		2.0	50		2.0	50	μA	$I_E = 0$	$V_{CB} = 75$ V
I_{EBO}	Emitter Cutoff Current			100			100	nA	$I_C = 0$	$V_{EB} = 4.0$ V
C_{obo}	Output Capacitance		6.0	9.0		6.0	12	pF	$I_E = 0$	$V_{CB} = 20$ V
C_{TE}	Emitter Transition Capacitance		70	80		70	80	pF	$I_C = 0$	$V_{EB} = 0.5$ V
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_C = 0$	$I_E = 0.1$ mA

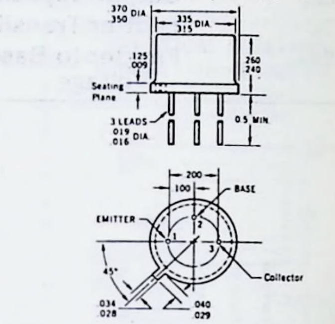
SE7055 • SE7056 • SE7057

NPN HIGH VOLTAGE VIDEO OUTPUT TRANSISTORS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **HIGH VOLTAGE . . . . V_{CEO} — 220 V TO 450 V (MIN) AT 5.0 mA**
- **LOW C_{cb} . . . . 2.5 pF TO 3.5 pF (MAX) AT 20 V**
- **HIGH FREQUENCY . . . . f_T — 40 TO 50 MHz (MIN); 80 MHz (TYP) AT 15 mA**
- **HIGH POWER DISSIPATION . . . 7.0 W AT $T_C = 25°C$; 1.0 W AT $T_A = 25°C$**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold-plated over nickel-flash on steel
Collector internally connected to case
Package weight is 0.76 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	**7.0 Watts**
at 25°C Ambient Temperature	**1.0 Watt**

Maximum Voltages

		SE7055	SE7056	SE7057	
V_{CBO}	Collector to Base Voltage	220	300	450	Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	220	300	450	Volts
V_{EBO}	Emitter to Base Voltage	7.0	7.0	7.0	Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	SE7055 MIN.	SE7055 TYP.	SE7055 MAX.	SE7056 MIN.	SE7056 TYP.	SE7056 MAX.	SE7057 MIN.	SE7057 TYP.	SE7057 MAX.	UNITS	TEST CONDITIONS	
C_{cb}	**Collector to Base Capacitance**		**3.0**	**3.5**		**2.5**	**3.0**		**2.0**	**2.5**	**pF**	**$I_E = 0$**	**$V_{CB} = 20$**
h_{fe}	High Frequency Current Gain	2.0	3.0									$I_C = 3.0$ mA	$V_{CE} = 200$
	(f = 20 MHz, $R_L = 6.7$ kΩ)	2.0	4.5									$I_C = 30$ mA	$V_{CE} = 20$
h_{fe}	High Frequency Current Gain				2.0	2.5						$I_C = 3.0$ mA	$V_{CE} = 270$
	(f = 20 MHz, $R_L = 9.0$ kΩ)				2.0	4.0						$I_C = 30$ mA	$V_{CE} = 30$
h_{fe}	High Frequency Current Gain							1.5	2.0			$I_C = 3.0$ mA	$V_{CE} = 405$
	(f = 20 MHz, $R_L = 13.5$ kΩ)							1.5	2.0			$I_C = 30$ mA	$V_{CE} = 40$
h_{fe}	**High Frequency Current Gain**	**2.5**	**4.0**									**$I_C = 15$ mA**	**$V_{CE} = 100$**
	(f = 20 MHz)				**2.5**	**4.0**						**$I_C = 15$ mA**	**$V_{CE} = 150$**
								2.0	**3.0**			**$I_C = 15$ mA**	**$V_{CE} = 200$**
h_{FE}	DC Pulse Current Gain (Note 5)	40	150		40	100		30	70			$I_C = 30$ mA	$V_{CE} = 20$
h_{FE}	DC Pulse Current Gain (Note 5)	40	150		40	100		30	70			$I_C = 10$ mA	$V_{CE} = 20$
h_{FE}	DC Current Gain	20	75		20	50		15	35			$I_C = 1.0$ mA	$V_{CE} = 20$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage**	**220**			**300**			**450**			**Volts**	**$I_C = 5.0$ mA**	**$I_B = 0$**
	(Notes 4 and 5)												
BV_{CBO}	Collector to Base Breakdown Voltage	220			300			450			Volts	$I_C = 100$ µA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			7.0			7.0			Volts	$I_E = 100$ µA	$I_C = 0$
I_{CBO}	Collector Cutoff Current		5.0	100							nA	$I_E = 0$	$V_{CB} = 150$
I_{CBO}(125°C)	Collector Cutoff Current		0.2	5.0							µA	$I_E = 0$	$V_{CB} = 150$
I_{CBO}	Collector Cutoff Current					1.0	100				nA	$I_E = 0$	$V_{CB} = 200$
I_{CBO}(125°C)	Collector Cutoff Current					0.2	5.0				µA	$I_E = 0$	$V_{CB} = 200$
I_{CBO}	Collector Cutoff Current								1.0	100	nA	$I_E = 0$	$V_{CB} = 300$
I_{CBO}(125°C)	Collector Cutoff Current								0.2	5.0	µA	$I_E = 0$	$V_{CB} = 300$
I_{EBO}	Emitter Cutoff Current		1.0	100		1.0	100		1.0	100	nA	$I_C = 0$	$V_{EB} = 6.0$
C_{eb}	Emitter to Base Capacitance		40	70		45	70		50	70	pF	$I_C = 0$	$V_{EB} = 0.5$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.74	0.85		0.74	0.85		0.74	0.85	Volts	$I_C = 20$ mA	$I_B = 2.0$ m
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.25	1.0		0.35	1.0		0.65	1.0	Volts	$I_C = 20$ mA	$I_B = 2.0$ m

*Planar is a patented Fairchild proces

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations. Note Power Dissipation Curves on Page 2.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C); junction to ambient ther resistance of 175°C/Watt (derating factor of 5.71 mW/°C).

(4) This rating refers to a high current point where collector to emitter voltage is lowest.

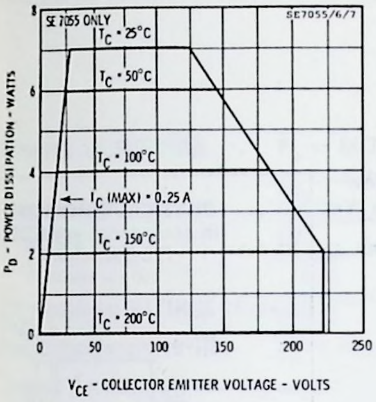
(5) Pulse Conditions: length = 300 µs; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

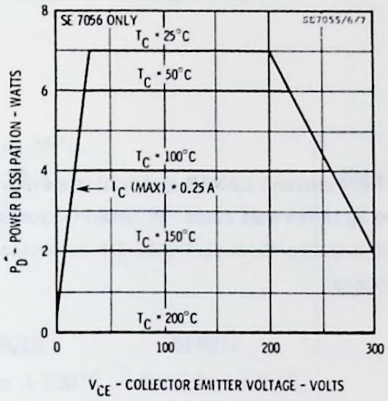
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

SAFE OPERATING AREAS

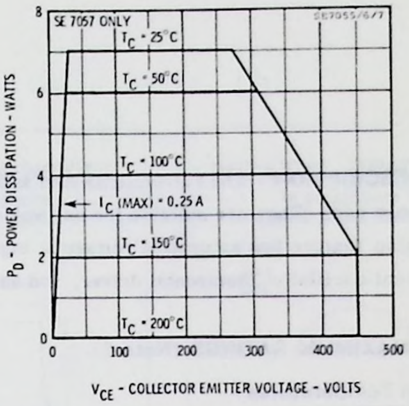
GUARANTEED MAXIMUM DC POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE



GUARANTEED MAXIMUM DC POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE

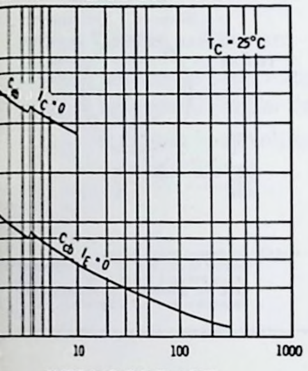


GUARANTEED MAXIMUM DC POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE

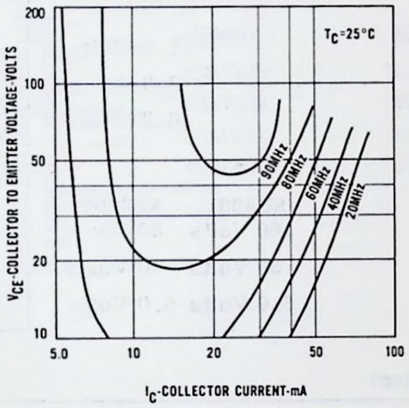


ELECTRICAL CHARACTERISTICS (SE7056 ONLY)

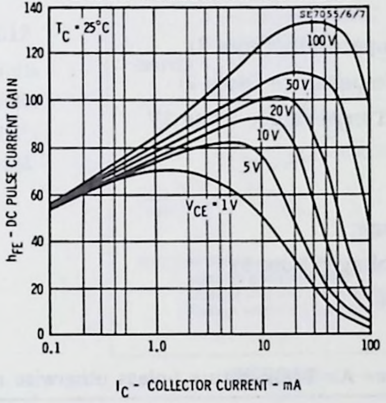
COLLECTOR TO BASE AND ITTER TO BASE CAPACITANCE RSUS REVERSE BIAS VOLTAGE



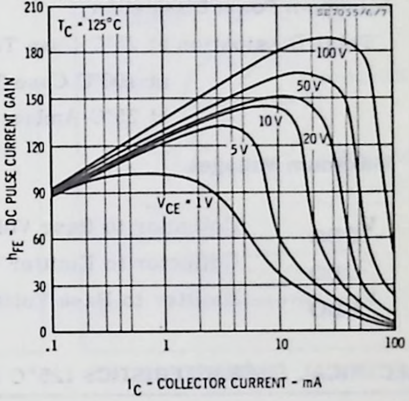
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



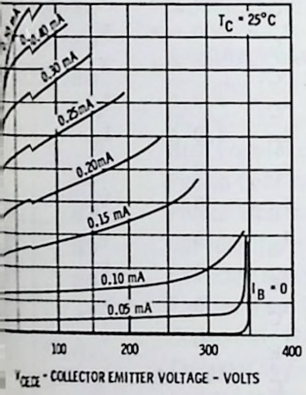
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



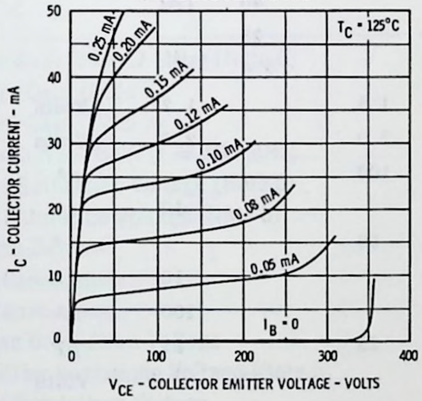
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



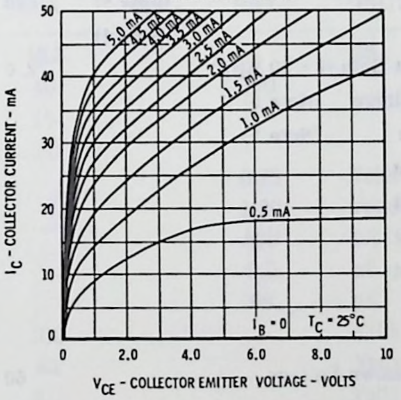
LARGE SIGNAL COLLECTOR CHARACTERISTIC*



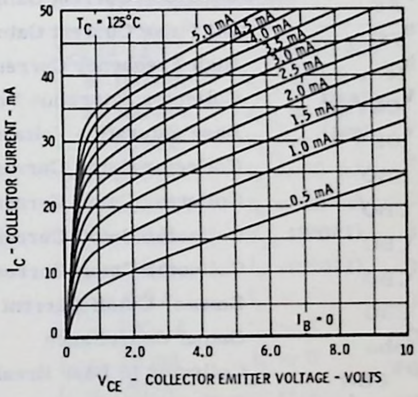
LARGE SIGNAL COLLECTOR CHARACTERISTIC*



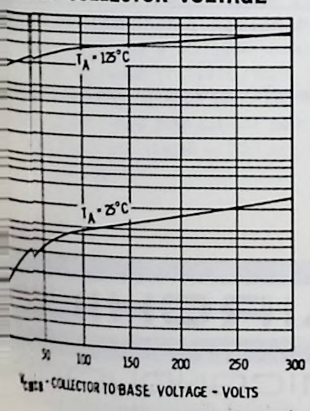
COLLECTOR SATURATION CHARACTERISTICS*



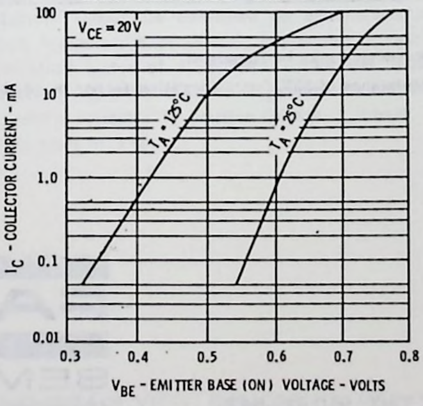
COLLECTOR SATURATION CHARACTERISTICS*



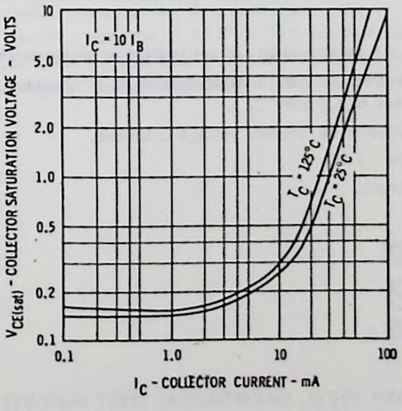
OLLECTOR CUTOFF CURRENT ERSUS COLLECTOR VOLTAGE



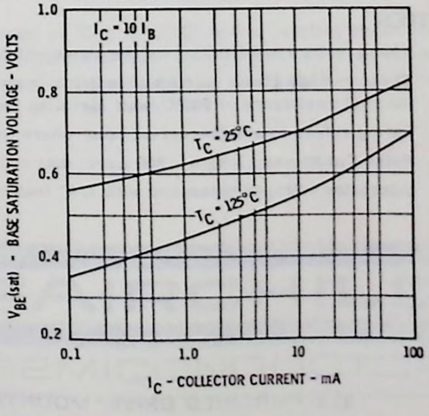
COLLECTOR CURRENT VERSUS EMITTER-BASE 'ON' VOLTAGE



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



ee family characteristics on Transistor Curve Tracer.

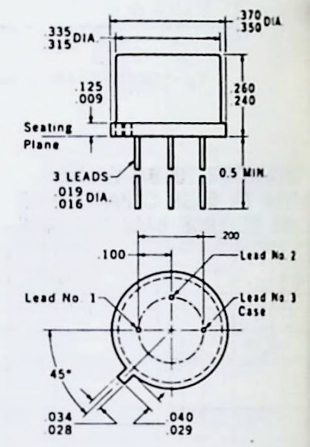
SE8001 • SE8002

NPN MEDIUM POWER

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The Fairchild SE8001 and SE8002 are NPN silicon PLANAR epitaxial transistors designed for general purpose use. They are suitable for one watt class "A" and up to ten watt class "B" audio output stages. These transistors also feature low saturation voltage at high current which makes them desirable for television applications such as vertical oscillator, horizontal driver, and audio output circuits.

PHYSICAL DIMENSIONS
in accordance with JEDEC
(TO-39) outline
(50 mil kovar)



NOTES: All dimensions in inches
Similar to package "C" except for lead le
Leads are gold-plated kovar
Lead No. 3 internally connected to case
Package weight is 1.23 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Operating Junction Temperature	200°C Maximum
Storage Temperature	-65°C to +200°C
Soldering Temperature (60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Note 2)	5.0 Watts
at 100°C Case Temperature (Note 2)	2.8 Watts
at 25°C Ambient Temperature (Note 2)	0.87 Watt

Maximum Voltages

		SE8001	SE8002
V_{CBO}	Collector to Base Voltage	60 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	30 Volts	40 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	SE8001 Min.	SE8001 Max.	SE8002 Min.	SE8002 Max.		Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 4)	20		40	120		I_C = 150 mA	V_{CE} = 1.0
h_{FE}	DC Pulse Current Gain (Note 4)			25			I_C = 500 mA	V_{CE} = 10
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0		2.0			I_C = 50 mA	V_{CE} = 10
$V_{CE}(sat)$	Collector Saturation Voltage (Note 5)		1.5		1.2	Volts	I_C = 1.0 A	I_B = 0.1
$V_{BE}(sat)$	Base Saturation Voltage (Note 5)		2.0		2.0	Volts	I_C = 1.0 A	I_B = 0.1
I_{CBO}	Collector Cutoff Current		100			nA	I_E = 0	V_{CB} = 40
I_{CBO}	Collector Cutoff Current				10	nA	I_E = 0	V_{CB} = 60
I_{CBO}(150°C)	Collector Cutoff Current		50			μA	I_E = 0	V_{CB} = 40
I_{CBO}(150°C)	Collector Cutoff Current				10	μA	I_E = 0	V_{CB} = 60
I_{EBO}	Emitter Cutoff Current				100	nA	I_C = 0	V_{EB} = 4.0
C_{obo}	Output Capacitance		25		25	pF	I_E = 0	V_{CB} = 10
BV_{CBO}	Collector to Base Breakdown Voltage	60		80		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	30		40		Volts	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		Volts	I_E = 100 μA	I_C = 0

* Planar is a patented Fairchild pr

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 35°C/watt (derating factor of 28.6 mW/°C. Junction-to-ambient thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μsec; duty cycle = 1.0%.

(5) Saturation voltages measured with 1/4" lead length.

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SE8010 · SE8012

NPN RF AMPLIFIER

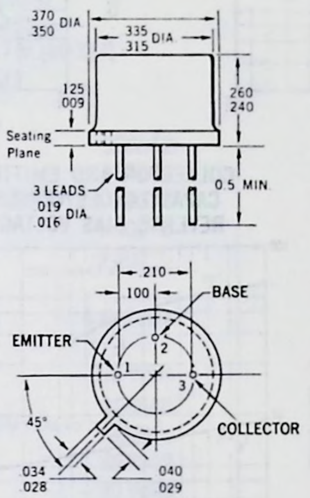
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

IGH POWER DISSIPATION . . . $P_D = 800$ mW AT $T_A = 25°C$
$P_D = 4.0$ W AT $T_C = 25°C$
IGH POWER GAIN . . . . 600 mW P_O AT 27 MHz
IGH VOLTAGE . . . . $LV_{CEO} = 60$ V

OLUTE MAXIMUM RATINGS (Note 1)

	SE8010	SE8012
aximum Temperatures		
Storage Temperature	−65°C to +200°C	−65°C to +125°C
Operating Junction Temperature	200°C Maximum	125°C Maximum
aximum Power Dissipation (Notes 2 and 3)	**SE8010**	**SE8012**
Total Dissipation at 25°C Case Temperature	**4.0 W**	**4.0 W**
at 25°C Free Air Temperature	**800 mW**	**500 mW**
aximum Voltages and Current	**SE8010**	**SE8012**
V_{CBO} Collector to Base Voltage	100 Volts	100 Volts
V_{CEO} **Collector to Emitter Voltage** (Note 4)	**60 Volts**	**60 Volts**
V_{EBO} Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C Collector Current	500 mA	500 mA

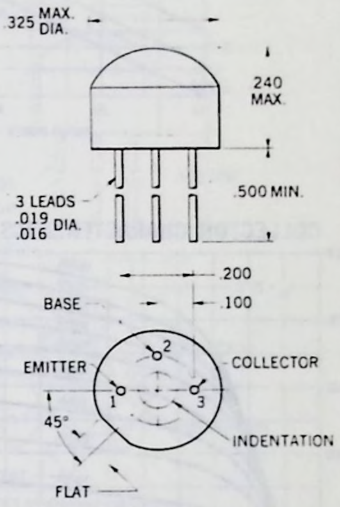
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 1.23 gram

SE8010

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

SE8012

*Planar is a patented Fairchild process.

RICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

MBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
E	**Amplifier Power Gain (f = 27 MHz)** (Note 6)	**10.8**	**12**		**dB**	$V_{CE} = 12$ V	$P_{in} = 50$ mW
E	DC Pulse Current Gain (Note 5)	40		150		$I_C = 100$ mA	$V_{CE} = 1.0$ V
E	DC Pulse Current Gain (Note 5)	15				$I_C = 500$ mA	$V_{CE} = 3.0$ V
	High Frequency Current Gain (f = 100 MHz)	3.0				$I_C = 50$ mA	$V_{CE} = 10$ V
E(sat)	Pulsed Collector Saturation Voltage (Note 5)			0.75	Volts	$I_C = 500$ mA	$I_B = 50$ mA
E(sat)	Pulsed Emitter Saturation Voltage (Note 5)			1.20	Volts	$I_C = 500$ mA	$I_B = 50$ mA
ES	Collector Reverse Current			500	nA	$V_{CE} = 50$ V	$V_{EB} = 0$
b	Collector-Base Capacitance			9.0	pF	$V_{CB} = 10$ V	$I_E = 0$
b	Emitter-Base Capacitance			65	pF	$V_{EB} = 0.5$ V	$I_C = 0$
CBO	Collector to Base Breakdown Voltage	100			Volts	$I_C = 100\ \mu A$	$I_E = 0$
EO(sus)	**Collector to Emitter Sustaining Voltage** (Note 5)	**60**			**Volts**	$I_C = 10$ mA	$I_B = 0$
EBO	Emitter to Base Breakdown Voltage	6.0			Volts	$I_E = 100\mu A$	$I_C = 0$

se ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
se are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
se ratings give a maximum junction temperature of 200°C, a junction to case thermal resistance of 43.8°C/Watt (derating factor of 22.8 mW/°C) and a junction to ambient rmal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the SE8010. These ratings give a maximum junction temperature of 125°C, a junction to case thermal stance of 25°C/Watt (derating factor of 40 mW/°C) and a junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C) for the SE8012.
ng refers to a high-current point where collector to emitter voltage is lowest.
se Conditions: length = 300 μs; duty cycle = 1%.
Test Circuit.

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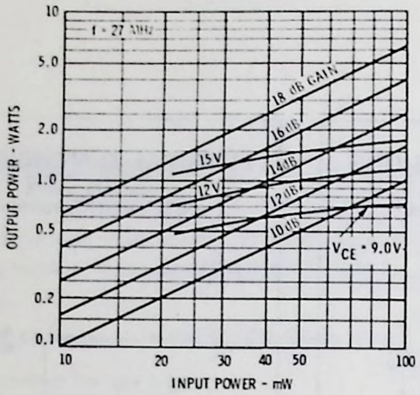
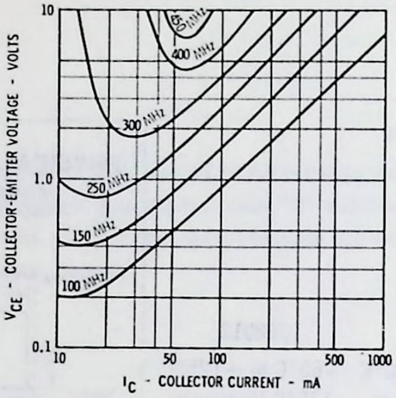
TYPICAL ELECTRICAL CHARACTERISTICS

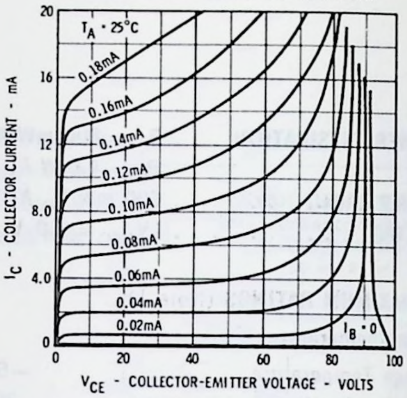
TYPICAL DRIVER AMPLIFIER PERFORMANCE



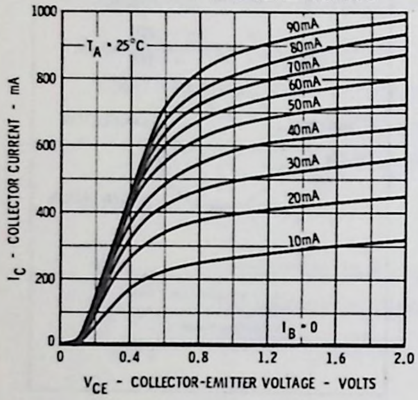
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



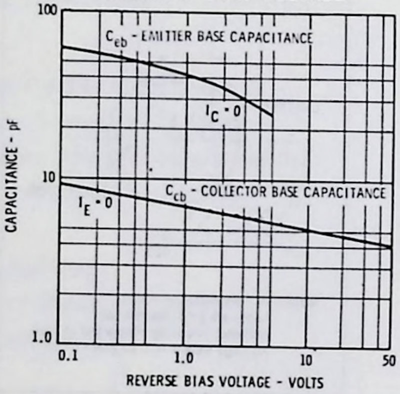
COLLECTOR CHARACTERISTICS*



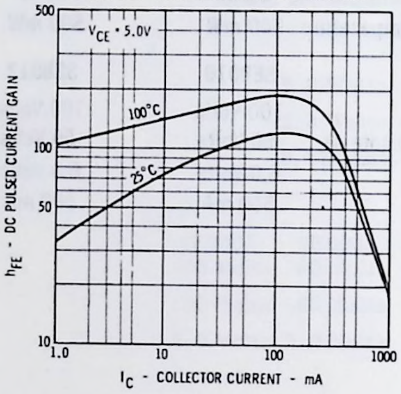
COLLECTOR CHARACTERISTICS*



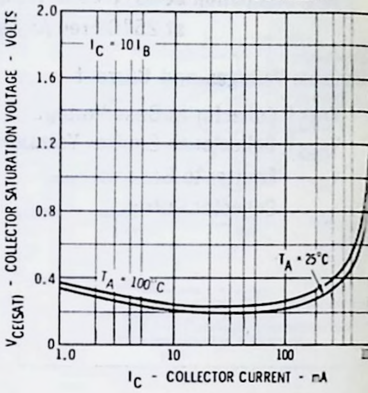
COLLECTOR AND EMITTER CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



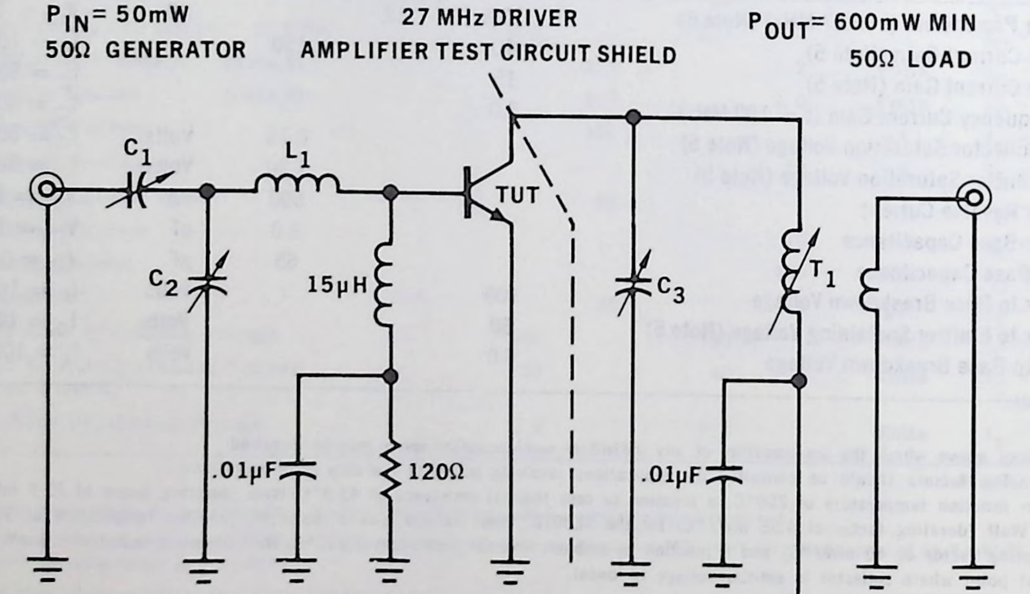
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



*Single family characteristic on Transistor Curve Tracer.


P_{IN} = 50mW
50Ω GENERATOR
27 MHz DRIVER
AMPLIFIER TEST CIRCUIT SHIELD
P_{OUT} = 600mW MIN
50Ω LOAD
C_1
L_1
TUT
C_2
15μH
C_3
T_1
.01μF
120Ω
.01μF
+12V AT 100mA(TYP)

C_1, C_2 — 7 to 100pF, compression mica trimmer (Arco 423)
C_3 — 43 to 63pF, compression mica trimmer (Arco 402) in parallel with 43pF. Dipped mica.
L_1 — 0.35μH (7 T Air Dux 408)
T_1 — 9 turns primary, 5 turns secondary
No. 18 enamel close wound on ¼ inch slug tuned form
(CTC 1535-2-2, red slug).

SE8040 · SE8041 · SE8042 · SE8540 · SE8541 · SE8542

NPN-PNP GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

MATCHED h_{FE} GROUPINGS AVAILABLE (See Note 7)

HIGH GAIN . . . . h_{FE} = 40-540 AT 150 mA, 1.0 V
h_{FE} = 30 (MIN) AT 500 mA, 1.0 V

NPN AND PNP COMPLEMENTS (Note 7) . . . SE8040, SE8041 AND SE8042 ARE NPN
SE8540, SE8541 AND SE8542 ARE PNP

LOW SATURATION VOLTAGE . . . . $V_{CE(sat)}$ = 0.12 V (MAX) AT 150 mA, 0.3 V (MAX) AT 500 mA FOR SE8040, SE8041 AND SE8042
$V_{CE(sat)}$ = —0.25 V (MAX) AT 150 mA, —0.7 V (MAX) AT 500 mA FOR SE8540, SE8541 AND SE8542

SOLUTE MAXIMUM RATINGS (Note 1)

	SE8040 SE8540	SE8041 SE8541	SE8042 SE8542
Maximum Temperatures			
Storage Temperature	−55°C to +125°C	−65°C to +200°C	−65°C to +200°C
Operating Junction Temperature	+125°C	+200°C	+200°C
Lead Temperature (Soldering, 10 second time limit)	+260°C	+300°C	+300°C
Maximum Power Dissipation (Notes 2, 3 and 4)			
Total Dissipation at or below 100°C Case Temperature			4.0 Watts
Total Dissipation at 25°C Case Temperature	4.0 Watts	4.0 Watts	
at 25°C Free Air Temperature	0.5 Watt	0.8 Watt	1.0 Watt

		SE8040 SE8041 SE8042	SE8540 SE8541 SE8542
Maximum Voltages and Current			
V_{CBO}	Collector to Base Voltage	30 Volts	−30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 5)	30 Volts	−30 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	−5.0 Volts
I_C	Continuous Collector Current ($T_C = +75°C$)	1.0 Amp	1.0 Amp
I_C	Continuous Collector Current ($T_C = +100°C$)	0.75 Amp	0.75 Amp

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

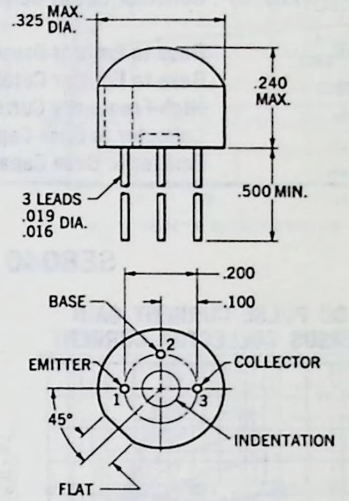
YMBOL	CHARACTERISTICS		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS (Reverse Voltage Polarity For PNP)	
E	**DC Pulse Current Gain** (Note 6)		**40**	**70**	**540**		I_C = 150 mA	V_{CE} = 1.0 V
E	**DC Pulse Current Gain** (Note 6)		**30**	**65**			I_C = 500 mA	V_{CE} = 1.0 V
$_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 5 & 6)	SE8040 SE8041, SE8042	30			Volts	I_C = 30 mA	I_B = 0
$_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 5 & 6)	SE8540 SE8541, SE8042	−30			Volts	I_C = 30 mA	I_B = 0
V_{CBO}	Collector to Base Breakdown Voltage	SE8040 SE8041, SE8042	30			Volts	I_C = 10 μA	I_E = 0
V_{CBO}	Collector to Base Breakdown Voltage	SE8540 SE8541, SE8542	−30			Volts	I_C = 100 μA	I_E = 0
$_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 6)	SE8040 SE8041, SE8042		0.35	1.0	Volts	I_C = 1.0 A	I_B = 33 mA
$_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 6)	SE8540 SE8541, SE8542		−0.5	−1.3	Volts	I_C = 1.0 A	I_B = 33 mA
$_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 6)**	**SE8040 SE8041, SE8042**		**0.2**	**0.3**	**Volts**	**I_C = 500 mA**	**I_B = 25 mA**
$_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 6)**	**SE8540 SE8541, SE8542**		**−0.3**	**−0.7**	**Volts**	**I_C = 500 mA**	**I_B = 25 mA**
$_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 6)**	**SE8040 SE8041, SE8042**		**0.08**	**0.12**	**Volts**	**I_C = 150 mA**	**I_B = 15 mA**
$_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 6)**	**SE8540 SE8541, SE8542**		**−0.15**	**−0.25**	**Volts**	**I_C = 150 mA**	**I_B = 15 mA**

ditional Electrical Characteristics on Page 2

Notes on Page 6

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-105) outline

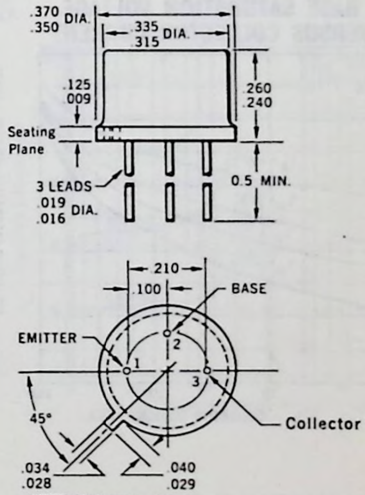


NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

SE8040 • SE8540

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 1.23 grams

SE8041 • SE8541
SE8042 • SE8542

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS SE8040 • SE8041 • SE8042 • SE8540 • SE8541 • SE8542

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

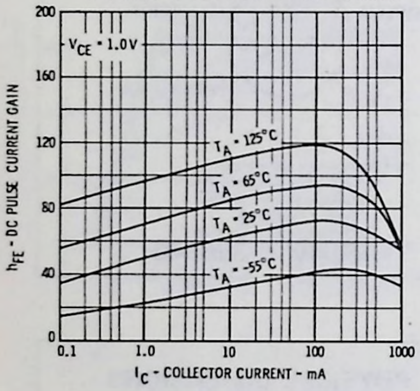
SYMBOL	CHARACTERISTICS	SE8040 • SE8041 • SE8042 MIN.	TYP.	MAX.	SE8540 • SE8541 • SE8542 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS (Reverse Voltage Polarity For SE8540 • SE8541 • SE8542)	
h_{FE}	DC Pulse Current Gain (Note 6)	30	60		30	68			$I_C = 10$ mA	$V_{CE} = 1.0$ V
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)		0.95	1.2		−0.96	−1.2	Volts	$I_C = 1.0$ A	$I_B = 33$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)		0.93	1.0		−0.92	−1.15	Volts	$I_C = 500$ mA	$I_B = 25$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)		0.82	0.85		−0.79	−1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(on)}$	Pulsed Base Emitter (On) Voltage (Note 6)	0.63	0.68	0.73	−0.65	−0.68	−0.75	Volts	$I_C = 20$ mA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Cutoff Current		0.9	50		0.1	50	nA	$I_E = 0$	$V_{CB} = 25$ V
I_{CBO}(65°C)	Collector Cutoff Current	(SE8040)	.008	5.0	(SE8540)	.002	1.0	μA	$I_E = 0$	$V_{CB} = 25$ V
I_{CBO}(125°C)	Collector Cutoff Current	(SE8041, SE8042)	0.1	20	(SE8541, SE8542)	0.1	20	μA	$I_E = 0$	$V_{CB} = 25$ V
BV_{EBO}	Base to Emitter Breakdown Voltage	6.0			−5.0			Volts	$I_E = 10$ μA	$I_C = 0$
I_{EBO}	Base to Emitter Cutoff Current		2.0	50		2.0	50	nA	$I_C = 0$	$V_{EB} = 4.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.3	2.3	5.0	1.0	2.0	5.0		$I_C = 50$ mA	$V_{CE} = 10$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		9.0	12		20	35	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		60	65		80	120	pF	$I_C = 0$	$V_{EB} = 0.5$ V

TYPICAL ELECTRICAL CHARACTERISTICS

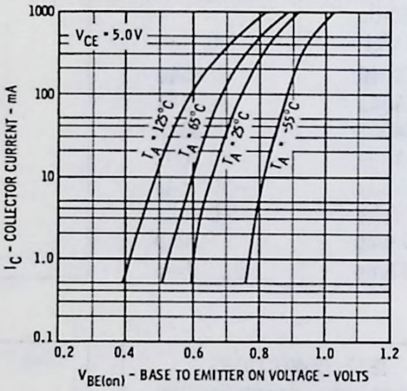
SE8040 • SE8041 • SE8042

SE8540 • SE8541 • SE8542

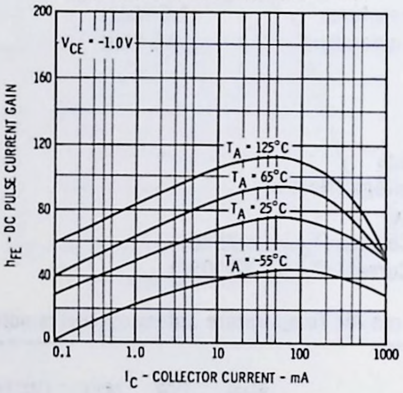
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



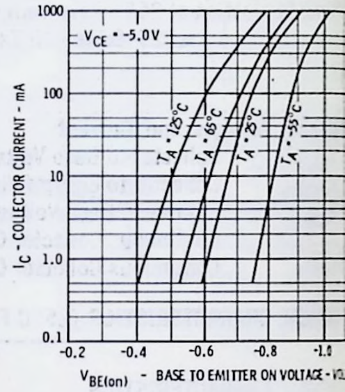
BASE TO EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



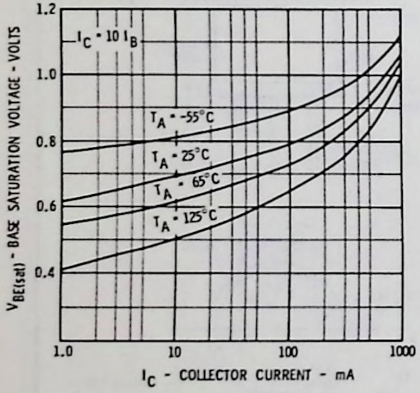
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



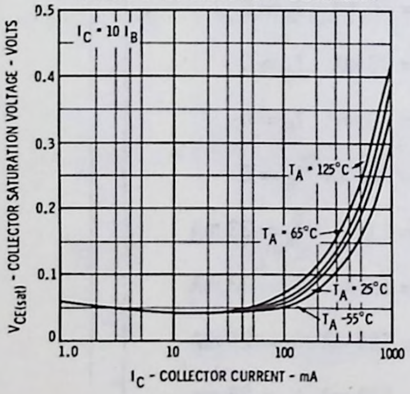
BASE TO EMITTER ON VOLTA VERSUS COLLECTOR CURREN



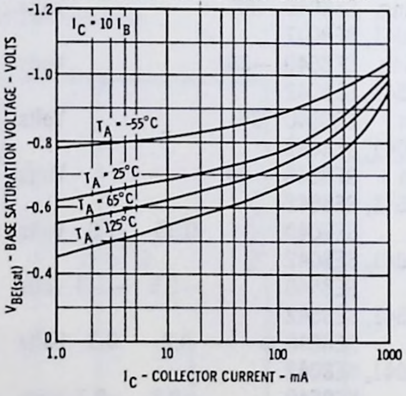
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



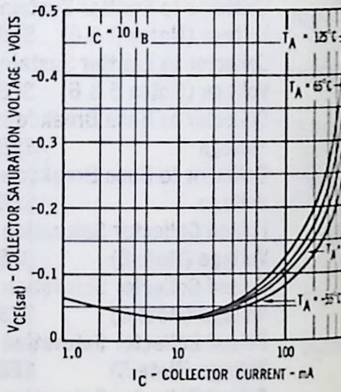
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



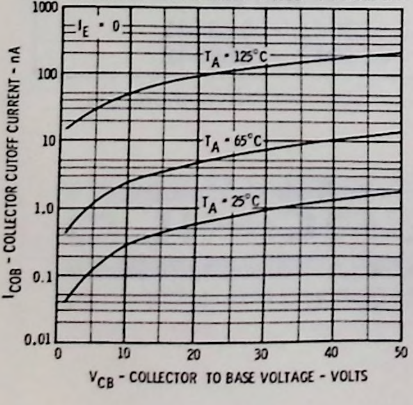
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



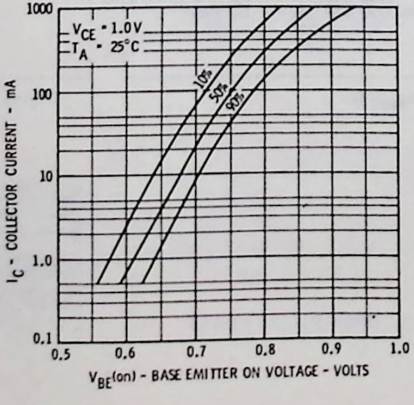
COLLECTOR SATURATION VOLT VERSUS COLLECTOR CURREN



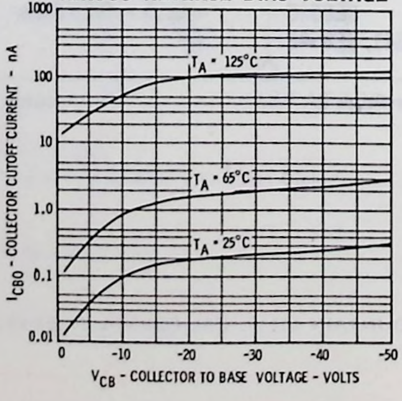
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



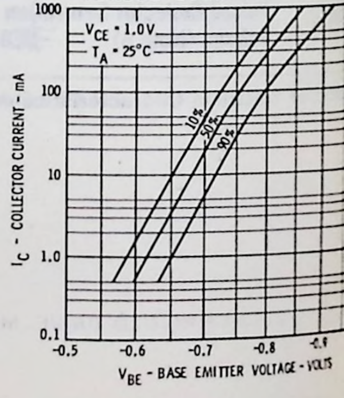
DISTRIBUTION OF BASE EMITTER VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE

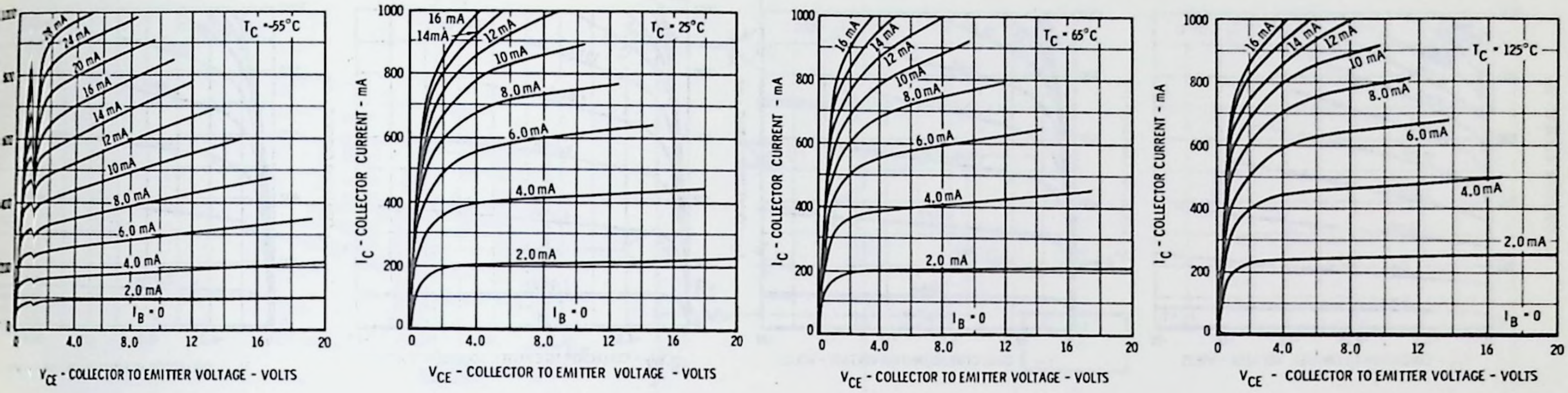


DISTRIBUTION OF BASE EMITTER VOLTAGE VERSUS COLLECTOR CURRE

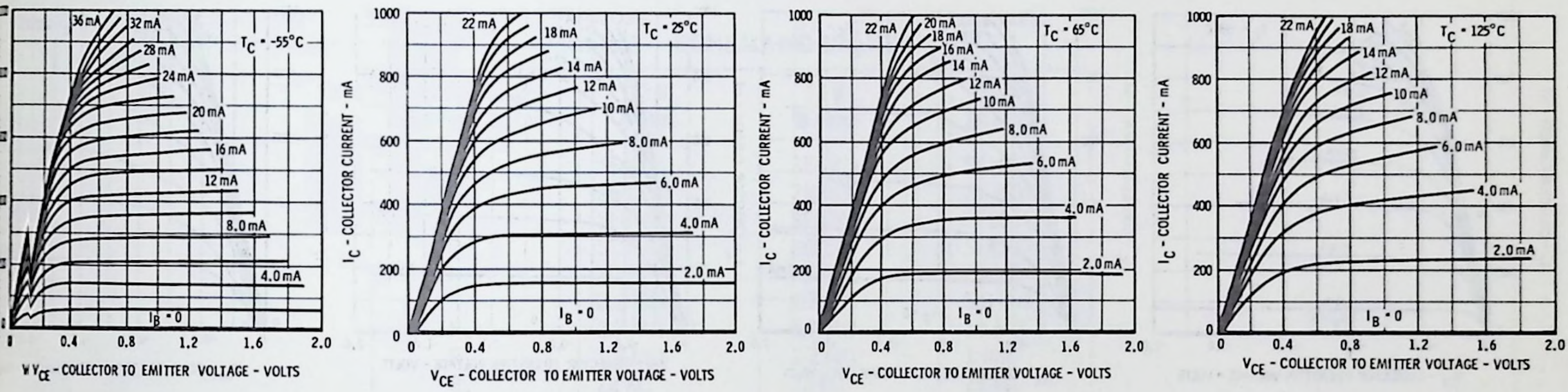


SE8040 • SE8041 • SE8042

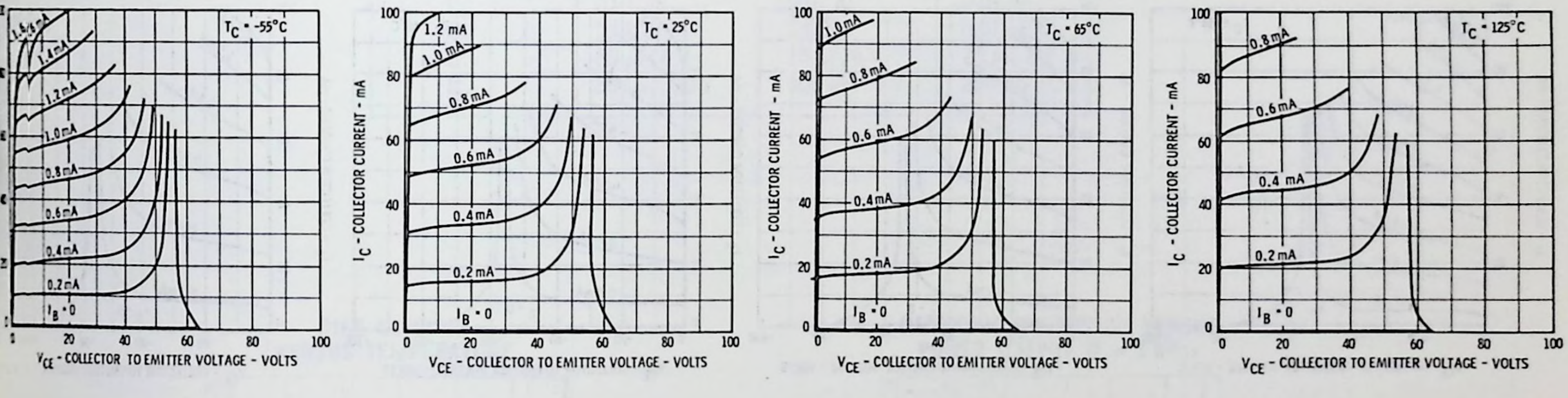
TYPICAL LARGE SIGNAL COLLECTOR CHARACTERISTICS



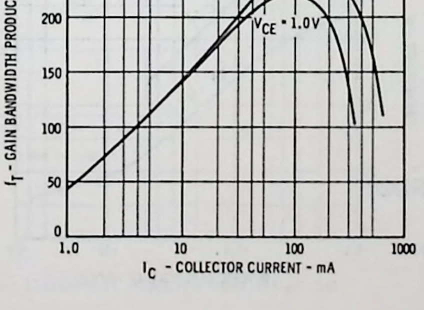
TYPICAL COLLECTOR SATURATION CHARACTERISTICS



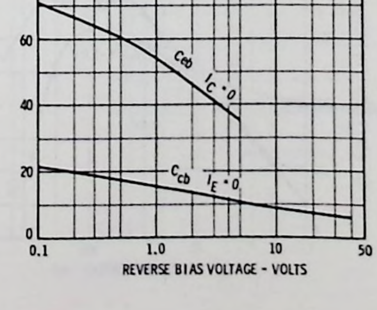
TYPICAL SMALL SIGNAL COLLECTOR CHARACTERISTICS



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

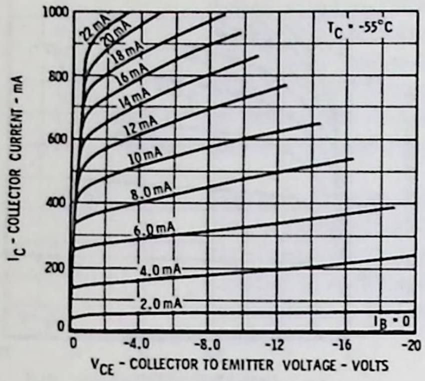


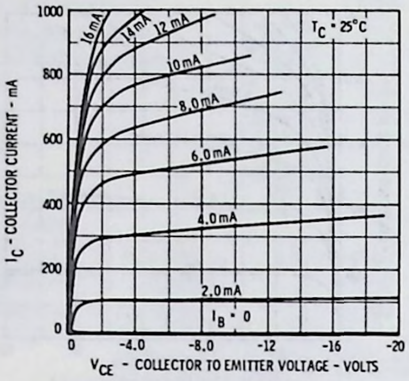
COLLECTOR TO BASE AND EMITTER TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

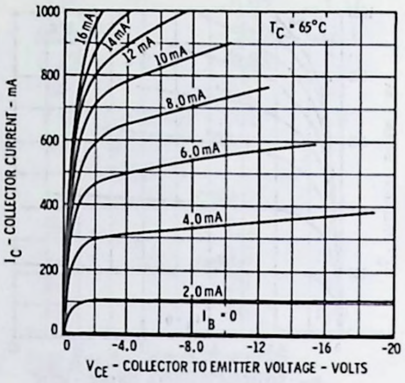


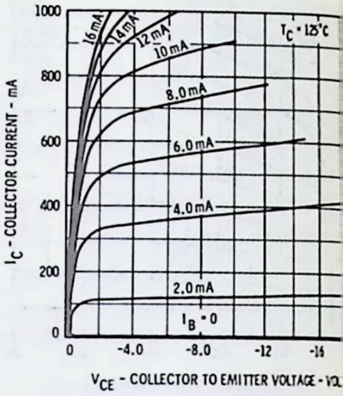
SE8540 • SE8541 • SE8542

TYPICAL LARGE SIGNAL COLLECTOR CHARACTERISTICS

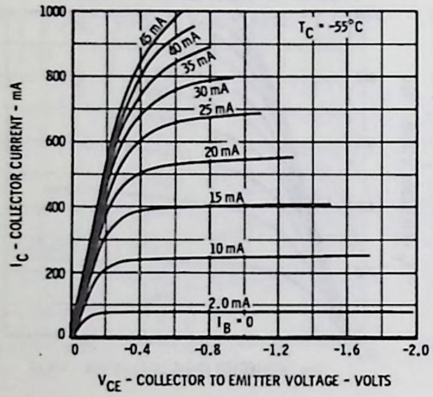


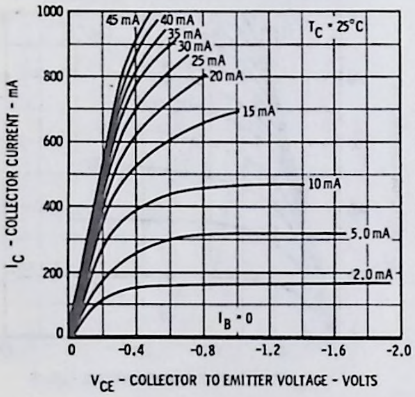


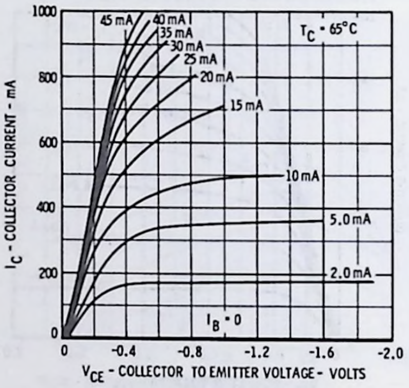


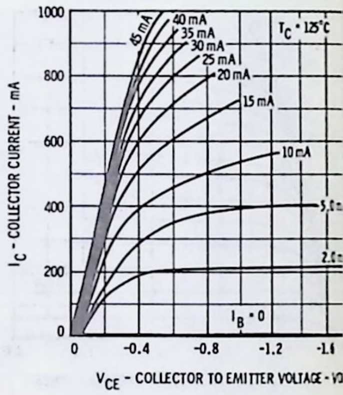


TYPICAL COLLECTOR SATURATION CHARACTERISTICS

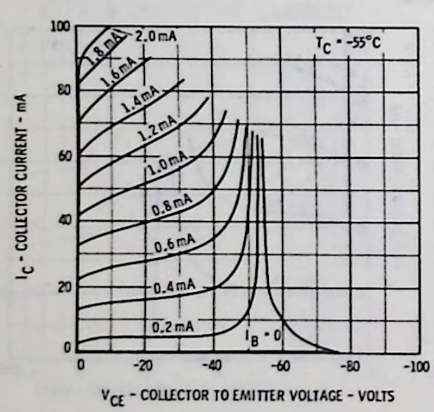


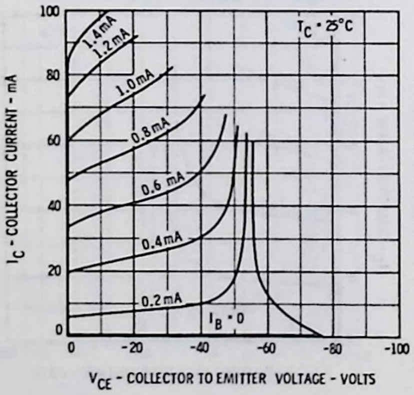


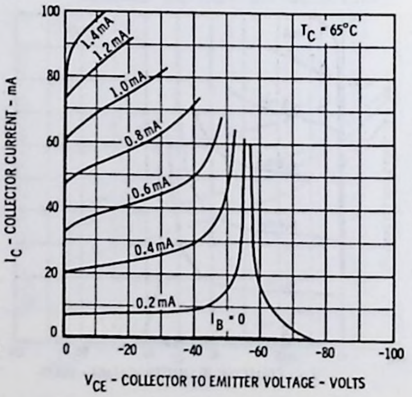


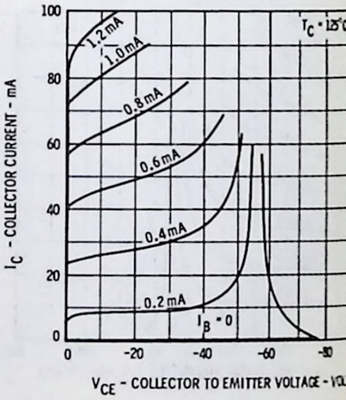


TYPICAL SMALL SIGNAL COLLECTOR CHARACTERISTICS

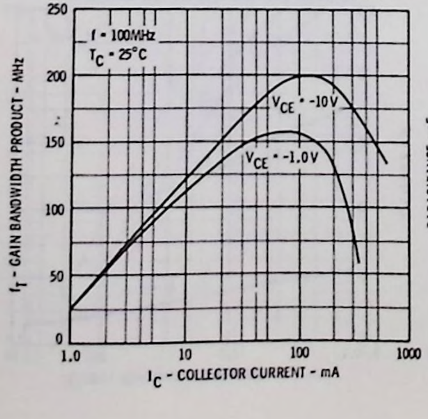








GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



COLLECTOR-BASE AND EMITTER BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

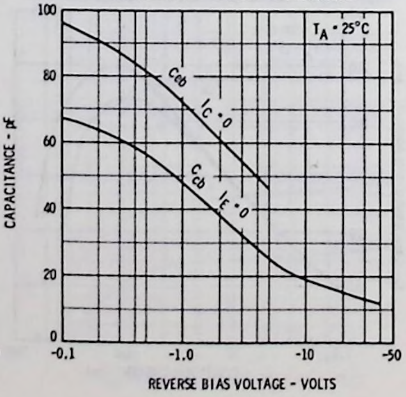


Figure 1—SCHEMATIC DIAGRAM

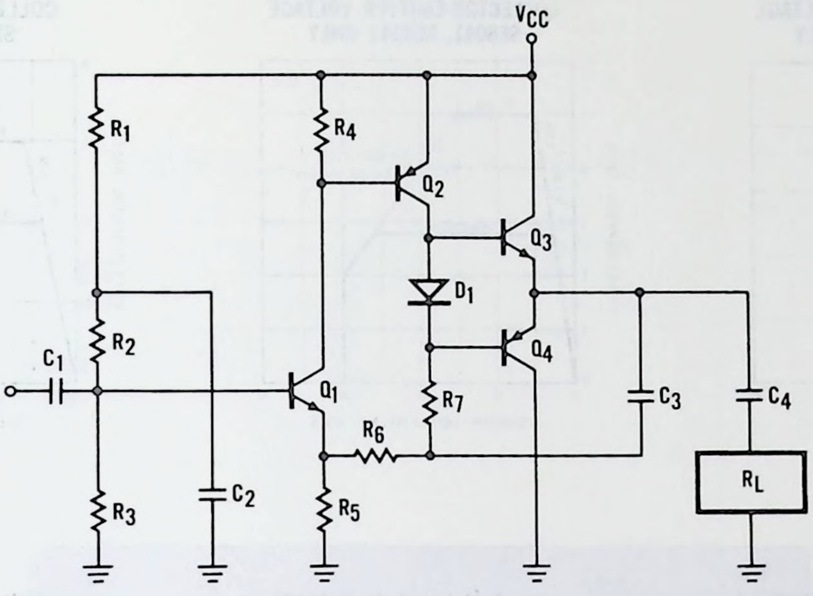
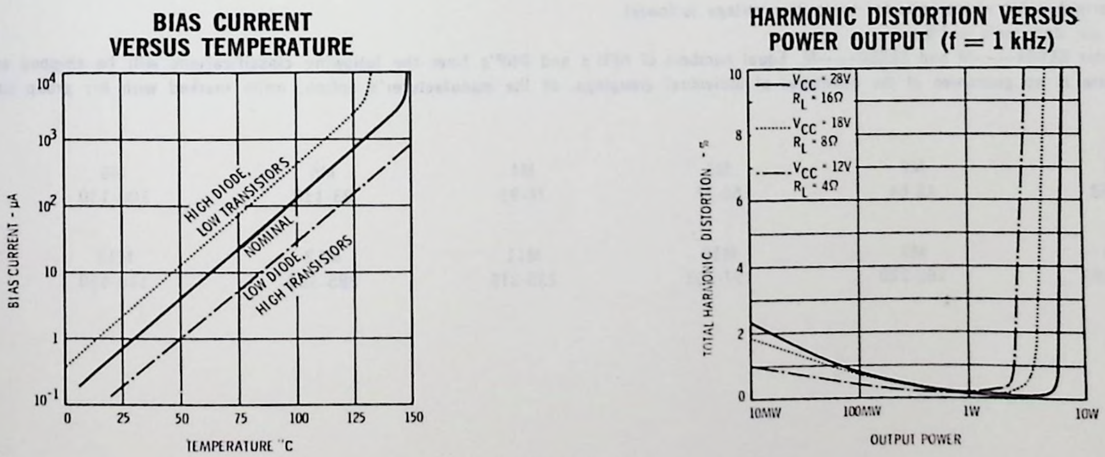


Table 1—SCHEMATIC VALUES

Circuit Voltage	12 V	18 V	28 V
Load Resistance	4 ohm	8 ohm	16 ohm
Q_1	SE4021	SE4021	SE4021
Q_2	2N4249	2N3638	2N3638
Q_3	SE8040	SE8040	SE8042
Q_4	SE8540	SE8540	SE8542
D_1	FDH694	FDH694	FDH694
R_1	2.2 MΩ	4.7 MΩ	5.6 MΩ
R_2	2.7 MΩ	4.7 MΩ	10 MΩ
R_3	1.2 MΩ	1.2 MΩ	1 MΩ
R_4	22 kΩ	22 kΩ	22 kΩ
R_5	100 Ω	47 kΩ	56 Ω
R_6	180 Ω	180 Ω	470 Ω
R_7	120 Ω	120 Ω	150 Ω
C_1	0.01 μF	0.01 μF	0.01 μF
C_2	0.01 μF	0.01 μF	0.01 μF
C_3	50 μF, 6 V	25 μF, 6 V	25 μF, 6 V
C_4	500 μF, 10 V	500 μF, 15 V	250 μF, 20 V

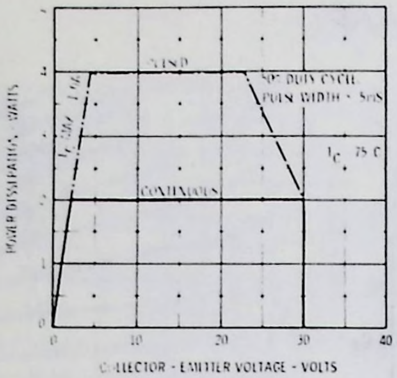

BIAS CURRENT VERSUS TEMPERATURE

HARMONIC DISTORTION VERSUS POWER OUTPUT (f = 1 kHz)

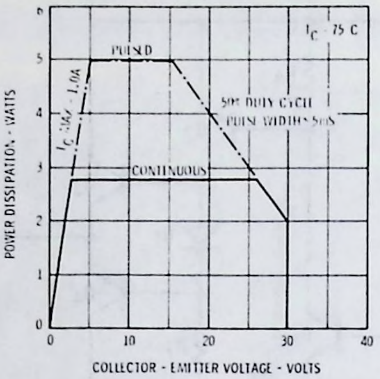
FIGURE 2

For additional information, send for Fairchild Application Brief 58

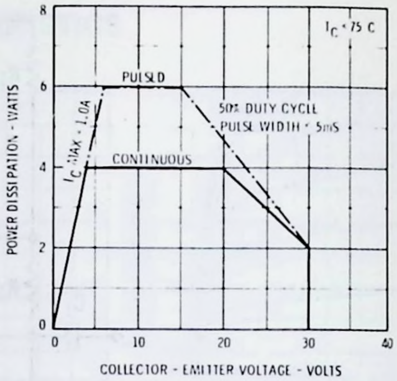
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8040, SE8540 ONLY



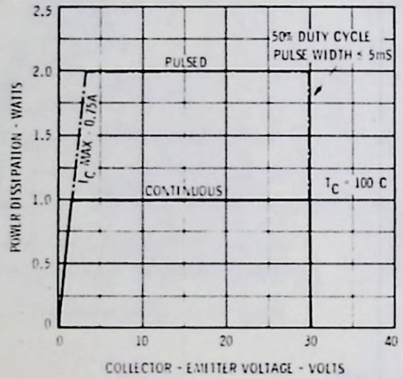
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8041, SE8541 ONLY



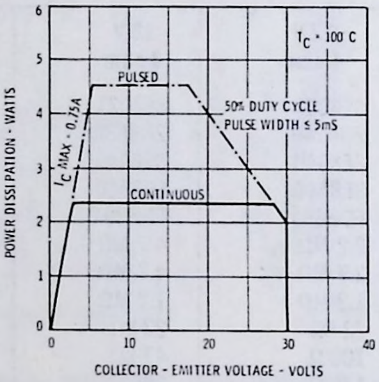
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8042, SE8542 ONLY



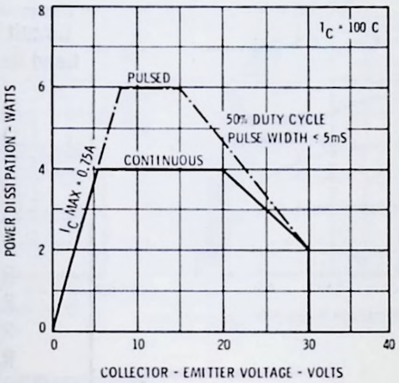
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8040, SE8540 ONLY



MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8041, SE8541 ONLY



MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8042, SE8542 ONLY



* Reverse Voltage Polarity for SE8540, SE8541 and SE8542

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations if curves shown above will be exceeded.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C) for the SE8040 and SE8540.

(4) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.7°C/Watt (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the SE8041 and SE8541; junction to ambient thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C) for the SE8042 and SE8542.

(5) This rating refers to a high current point where collector to emitter voltage is lowest.

(6) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(7) If h_{FE} matching is required, order SE804——M and SE854——M. Equal numbers of NPN's and PNP's from the following classifications will be shipped and will be marked to indicate matching group(s). There is no guarantee of the quantities of individual groupings. At the manufacturer's option, units marked with h_{FE} group suffixes (M1, etc.) may be shipped as SE8040 etc.

GROUP	M1	M2	M3	M4	M5	M6	M7
h_{FE} RANGE	40-52	48-64	58-77	70-93	83-110	100-130	118-150
I_C = 150 mA	M8	M9	M10	M11	M12	M13	M14
V_{CE} = 1.0 V	135-183	163-220	197-263	235-315	285-380	340-450	410-540

Plastic Miniature Transistors

PLASTIC MINIATURE TRANSISTORS

Fairchild has a complete family of 26 miniature plastic transistors, designated micro-pak™, which have electrical characteristics similar to their popular metal can counterparts and will meet reliability levels comparable to metal can transistors.

The micro-pak package™ configuration, 80 mils square with radial ribbon leads, was developed for use in military and computer systems where size and weight and reliability considerations are important. The high degree of shock resistance inherent in its inert single-block construction makes it ideal for warhead fuzes or missiles.

PLASTIC MINIATURE TRANSISTOR NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
FX709	3-1	FX3013	3-13	FX3963	3-21
FX914	3-3	FX3014	3-14	FX3964	3-21
FX918	3-5	FX3299	3-15	FX3965	3-21
FX2368	3-7	FX3300	3-15	FX4034	3-23
FX2369A	3-7	FX3502	3-17	FX4046	3-25
FX2483	3-9	FX3503	3-17	FX4047	3-25
FX2484	3-9	FX3724	3-19	FX4207	3-27
FX2894	3-11	FX3725	3-19	FX4960	3-29
FX2894A	3-11	FX3962	3-21		

FX709

NPN HIGH SPEED SATURATED SWITCH

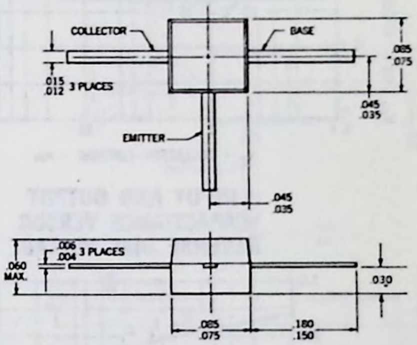
μPAK™ DIFFUSED SILICON PLANAR* TRANSISTOR

FOR ADDITIONAL INFORMATION SEE 2N709

IMILAR TO 2N709
IGH FREQUENCY . . . τ_s = 6.0 ns (MAX) AT 5.0 mA
t_{on} and t_{off} = 12 ns (MAX) AT 10 mA
IGH SPEED . . . . . . f_T = 600 MHz (MIN) AT 10 mA

PHYSICAL DIMENSIONS

MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

OLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +175°C
Operating Junction Temperature		+175°C
Lead Temperature (Soldering, 10 second time limit)		+260°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C		0.210 Watt
Maximum Voltages		
V_{CBO}	Collector to Base Voltage	15 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	6.0 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$_{FE}$	DC Pulse Current Gain	20	55	120		I_C = 1 mA	V_{CE} = 0.5 V
$_{FE}$	DC Pulse Current Gain	30	70	125		I_C = 10 mA	V_{CE} = 0.4 V
$_{FE}$(−55°C)	DC Pulse Current Gain	10				I_C = 10 mA	V_{CE} = 0.5 V
$_{BE(sat)}$	Base Saturation Voltage	0.70	0.78	0.85	Volts	I_C = 3.0 mA	I_B = 0.15 mA
$_{CE(sat)}$	Collector Saturation Voltage		0.21	0.30	Volts	I_C = 3.0 mA	I_B = 0.15 mA
$_{cb}$	Collector-Base Capacitance		2.5	3.0	pF	I_E = 0	V_{CB} = 5.0 V
$_{eb}$	Emitter-Base Capacitance		1.4	2.0	pF	I_C = 0	V_{EB} = 0.5 V
$_{CBO}$	Collector Cutoff Current		5.0	50	nA	I_E = 0	V_{CB} = 5.0 V
$_{CBO}$(125°C)	Collector Cutoff Current		1.0	5.0	μA	I_E = 0	V_{CB} = 5.0 V
V_{CBO}	Collector to Base Breakdown Voltage	15			Volts	I_C = 10 μA	I_E = 0
$_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	6.0			Volts	I_C = 10 mA (pulsed)	I_B = 0
V_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	I_E = 10 μA	I_C = 0
$_s$	**Charge Storage Time Constant** (Notes 6 and 7)		**3.0**	**6.0**	ns	$I_C = I_{B1} \approx 5.0$ mA,	$I_{B2} \approx -5.0$ mA
$_{on}$	**Turn On Time** (Note 7)		**6.0**	**12**	ns	$I_C \approx 10$ mA	$I_{B1} \approx 2.0$ mA
$_{off}$	**Turn Off Time** (Note 7)		**6.0**	**12**	ns	$I_C \approx 10$ mA, $I_{B1} \approx 1.0$ mA,	$I_{B2} \approx -1.0$ mA
	Gain Bandwidth Product (f = 100 MHz)	600	800		MHz	I_C = 10 mA	V_{CE} = 4.0 V

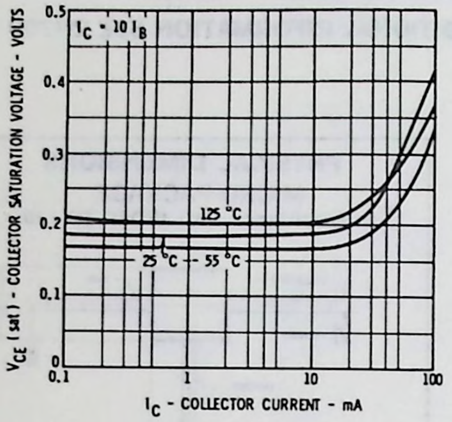
s on Page 2

*Planar is a patented Fairchild process.

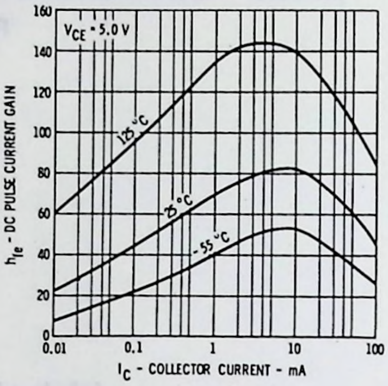
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

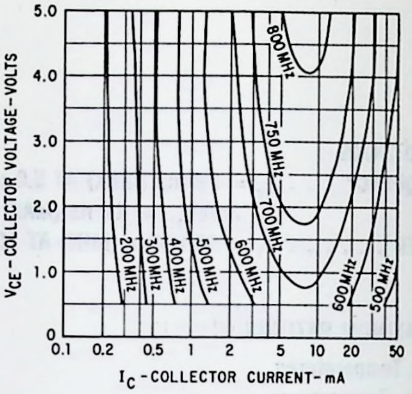
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



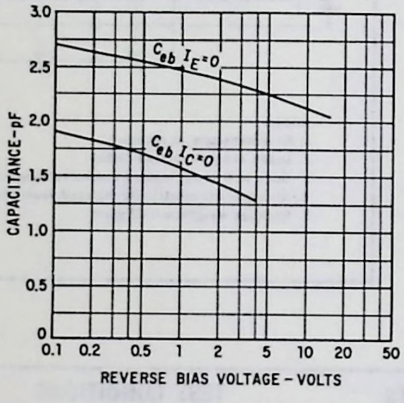
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



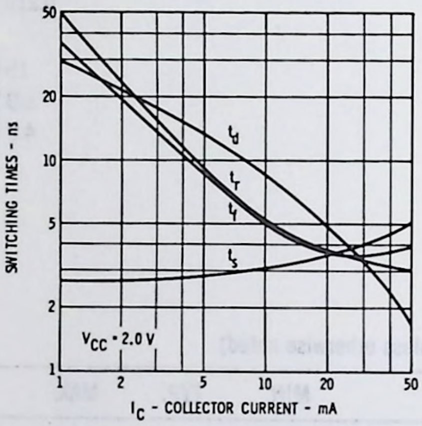
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



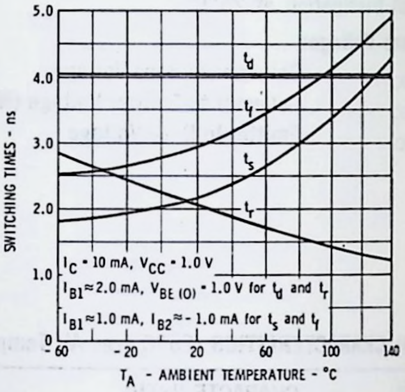
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



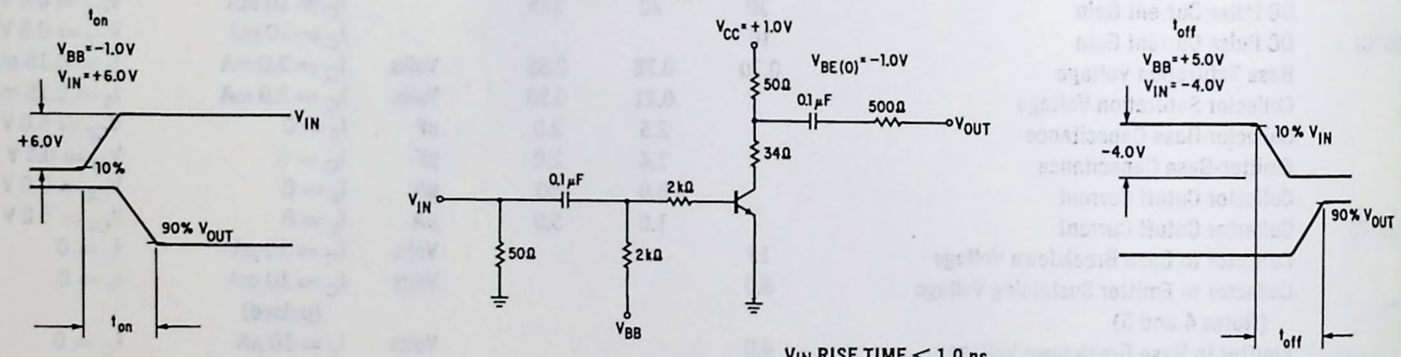
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

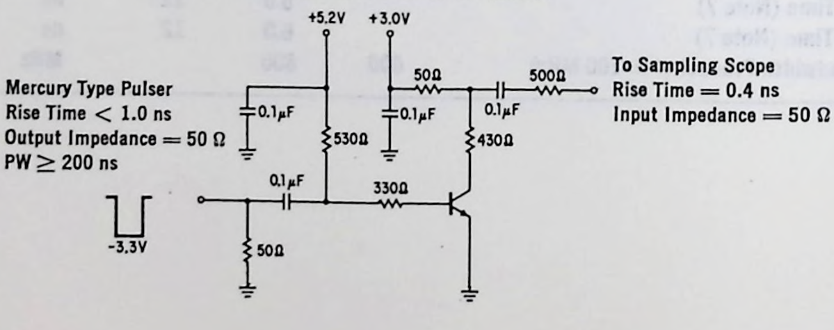


t_{on} AND t_{off} TEST CIRCUIT


t_{on}
$V_{BB} = -1.0$V
$V_{IN} = +6.0$V
V_{IN}
+6.0V
10%
90% V_{OUT}
t_{on}
$V_{CC} = +1.0$V
$V_{BE(O)} = -1.0$V
50Ω
0.1μF
500Ω
V_{OUT}
34Ω
V_{IN}
0.1μF
2kΩ
50Ω
2kΩ
V_{BB}
t_{off}
$V_{BB} = +5.0$V
$V_{IN} = -4.0$V
10% V_{IN}
-4.0V
90% V_{OUT}
t_{off}

VIN RISE TIME ≤ 1.0 ns

CHARGE STORAGE TIME CONSTANT TEST CIRCUIT


+5.2V
+3.0V
50Ω
500Ω
0.1μF
0.1μF
0.1μF
530Ω
430Ω
0.1μF
330Ω
50Ω
-3.3V

Mercury Type Pulser
Rise Time < 1.0 ns
Output Impedance = 50 Ω
PW ≥ 200 ns

To Sampling Scope
Rise Time = 0.4 ns
Input Impedance = 50 Ω

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 715°C/Watt (derating factor of 1.4 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) Measured on Sampling Scope. PW ≥ 200 ns.
(7) See test circuit for exact values of I_C, I_{B1}, and I_{B2}.

* Single family characteristic on Transistor Curve Tracer.

FX914

NPN SATURATED LOGIC SWITCH AND VHF AMPLIFIER

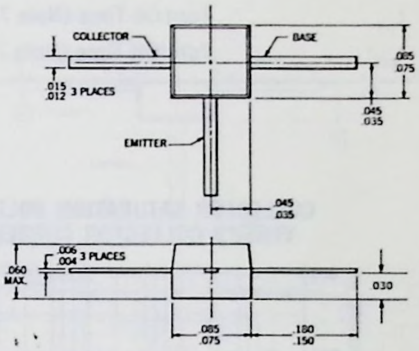
µPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR ADDITIONAL INFORMATION SEE 2N914

SIMILAR TO 2N914
HIGH SPEED . . . . $\tau_s = 25$ ns (MAX) AT 20 mA
MEDIUM VOLTAGE . . . . $LV_{CEO} = 15$ V (MIN)
LOW SATURATION VOLTAGE . . . $V_{CE(sat)} = 0.25$ V (MAX) AT 20 mA

PHYSICAL DIMENSIONS

MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transter molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +175°C
Operating Junction Temperature		+175°C
Lead Temperature (Soldering, 10 second time limit)		+260°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C		0.270 Watt
Maximum Voltages		
V_{CBO}	Collector to Base Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	30	55	120		$I_C = 10$ mA	$V_{CE} = 1.0$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	12	28			$I_C = 10$ mA	$V_{CE} = 1.0$ V
$V_{BE(sat)}$	Base Saturation Voltage	0.70	0.74	0.80	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.40	0.70	Volts	$I_C = 200$ mA	$I_B = 20$ mA
$V_{CE(sat)}$	**Collector Saturation Voltage (−55°C to +125°C)**		**0.20**	**0.25**	**Volts**	$I_C = 10\ I_B$	$I_C = 1.0$ to 20 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	3.7			$I_C = 15$ mA	$V_{CE} = 10$ V
C_{cb}	Collector-Base Capacitance		4.5	6.0	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance			9.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V

ditional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process.

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 175°C and a thermal resistance of 555°C/Watt (derating factor of 1.8 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.
Rating refers to a high-current point where collector to emitter voltage is lowest..
Pulse Conditions: length = 300 µs; duty cycle = 1%.
Measured on Sampling Scope. PW ≥200 ns.
See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
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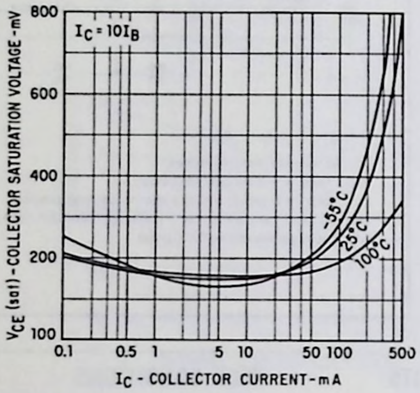
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

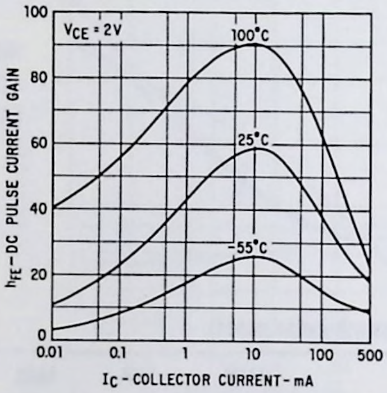
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	Collector Cutoff Current		4.0	25	nA	$I_E = 0$	$V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	$I_C = 1.0\ \mu A$	$I_E = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**15**			**Volts**	**$I_C = 10$ mA**	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
I_{CEX}(125°C)	Collector Current		3.0	10	μA	$V_{CE} = 20$ V	$V_{BE} = 0.25$ V
τ_s	**Charge Storage Time Constant** (Notes 6 and 7)		**13**	**25**	**ns**	**$I_C = I_{B1} \approx 20$ mA,**	**$I_{B2} \approx -20$ mA**
t_{on}	Turn On Time (Note 7)		25	40	ns	(See Test Circuit)	
t_{off}	Turn Off Time (Note 7)		25	40	ns	(See Test Circuit)	

TYPICAL ELECTRICAL CHARACTERISTICS

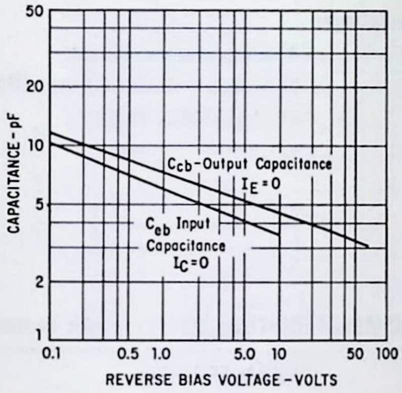
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



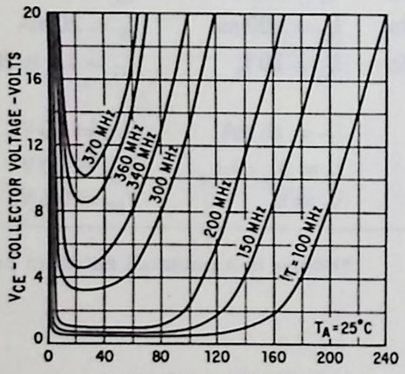
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



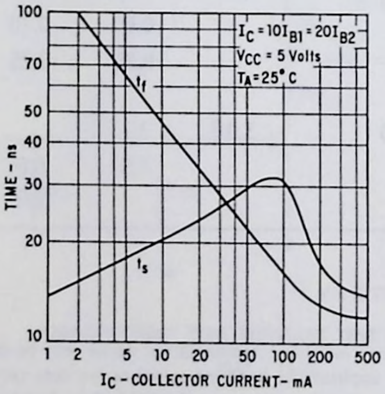
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



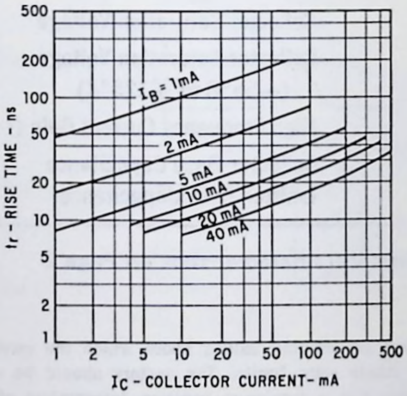
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



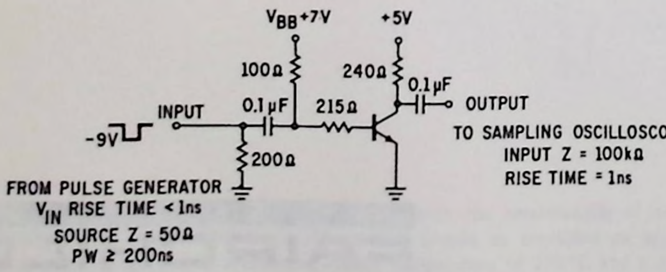
STORAGE AND FALL TIMES VERSUS COLLECTOR CURRENT



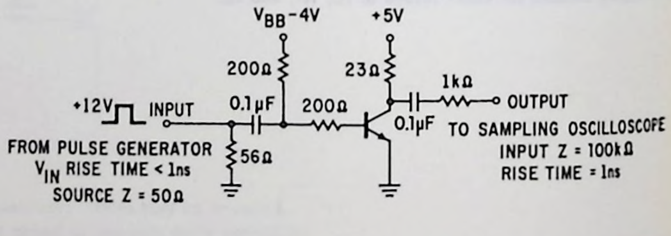
RISE TIME VERSUS COLLECTOR CURRENTS



CHARGE STORAGE TIME-CONSTANT TEST CIRCUIT


V_{BB}+7V
+5V
100Ω
240Ω
0.1μF
-9V
INPUT
0.1μF
215Ω
200Ω
OUTPUT
TO SAMPLING OSCILLOSCOPE
INPUT Z = 100kΩ
RISE TIME = 1ns
FROM PULSE GENERATOR
V_{IN} RISE TIME < 1ns
SOURCE Z = 50Ω
PW ≥ 200ns

t_{on} AND t_{off} TEST CIRCUIT


V_{BB}-4V
+5V
200Ω
23Ω
1kΩ
+12V
INPUT
0.1μF
200Ω
0.1μF
OUTPUT
56Ω
TO SAMPLING OSCILLOSCOPE
INPUT Z = 100kΩ
RISE TIME = 1ns
FROM PULSE GENERATOR
V_{IN} RISE TIME < 1ns
SOURCE Z = 50Ω

FX918

NPN ULTRA HIGH FREQUENCY OSCILLATOR AND AMPLIFIER

μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR ADDITIONAL INFORMATION SEE 2N918

SIMILAR TO 2N918

HIGH GAIN . . . . G_{pe} = 14 dB (MIN) AT 200 MHz

HIGH OSCILLATOR POWER OUT . . . . P_o = 25 mW (MIN) AT 500 MHz

LOW NOISE . . . . NF = 6.0 dB (MAX) AT 60 MHz

LOW CAPACITANCE . . . . C_{cb} = 1.7 pF (MAX) AT 10 V
C_{eb} = 2.0 pF (MAX) AT 0.5 V

HIGH FREQUENCY . . . . f_T = 600 MHz (MIN) AT 4.0 mA

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 Second Time Limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.240 Watt

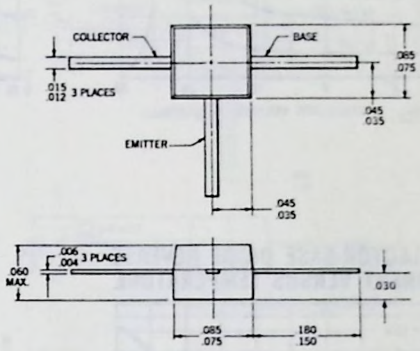
Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA

PHYSICAL DIMENSIONS

MICRO-PACKAGE

In accordance with JEDEC TO-120



NOTES:

1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	50			I_C = 3.0 mA	V_{CE} = 1.0 V
$V_{BE(sat)}$	Base Saturation Voltage			1.0	Volts	I_C = 10 mA	I_B = 1.0 mA
$V_{CE(sat)}$	Collector Saturation Voltage			0.4	Volts	I_C = 10 mA	I_B = 1.0 mA
C_{cb}	**Collector-Base Capacitance**		**1.0**	**1.7**	**pF**	**I_E = 0**	**V_{CB} = 10 V**
C_{cb}	Collector-Base Capacitance		1.8	3.0	pF	I_E = 0	V_{CB} = 0
C_{eb}	Emitter-Base Capacitance			2.0	pF	I_C = 0	V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current			10	nA	I_E = 0	V_{CB} = 15 V
I_{CBO}(125°C)	Collector Cutoff Current			1.0	μA	I_E = 0	V_{CB} = 15 V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**6.0**	**9.0**			**I_C = 4.0 mA**	**V_{CE} = 10 V**
G_{pe}	**Available Power Gain** (neutralized) **(f = 200 MHz)**	**14**	**18**		**dB**	**I_C = 6.0 mA**	**V_{CB} = 12 V**
P_o	**Power Output (f = 500 MHz)**	**25**	**40**		**mW**	**I_C = 8.0 mA**	**V_{CB} = 15 V**
η	Collector Efficiency (f = 500 MHz)	21			%	I_C = 8.0 mA	V_{CB} = 15 V
NF	**Noise Figure** (Note 5)		**3.0**	**6.0**	**dB**	**I_C = 1.0 mA**	**V_{CE} = 6.0 V**
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 4)	15			Volts	I_C = 3.0 mA	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	I_C = 1.0 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_C = 0	I_E = 10 μA

e notes on back page)

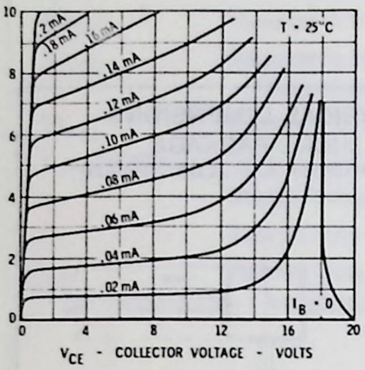
*Planar is a patented Fairchild process.

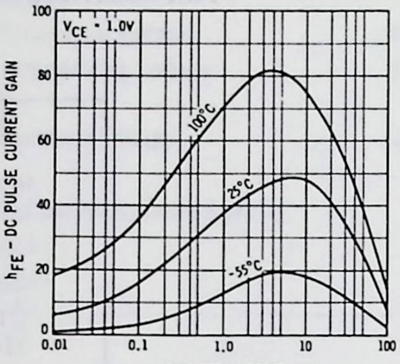
FAIRCHILD

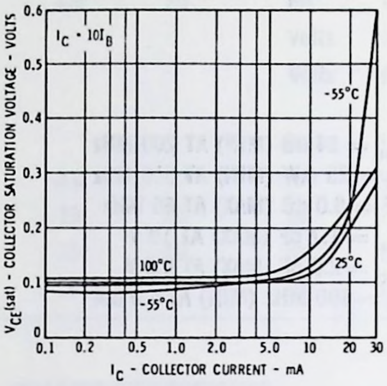
SEMICONDUCTOR

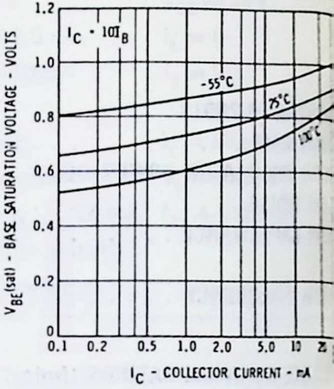
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

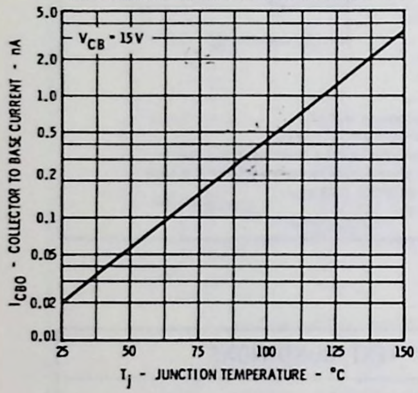
TYPICAL ELECTRICAL CHARACTERISTICS

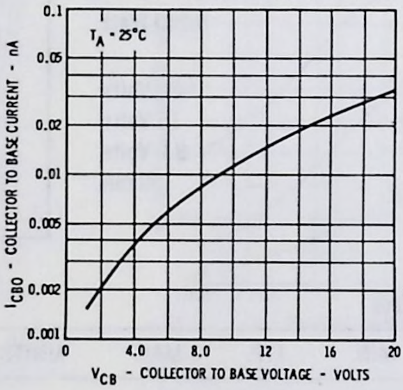

COLLECTOR CHARACTERISTICS*

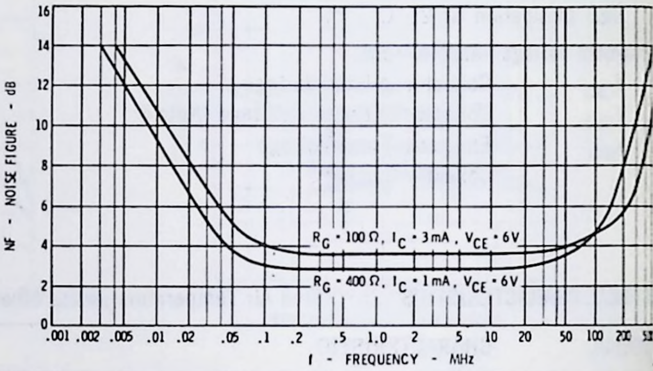

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

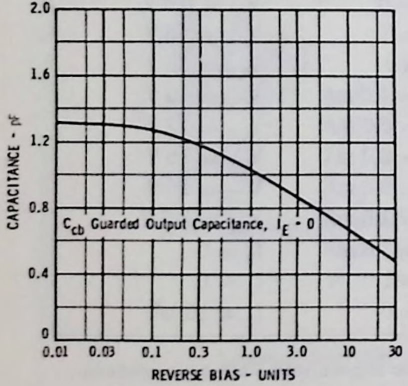

COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

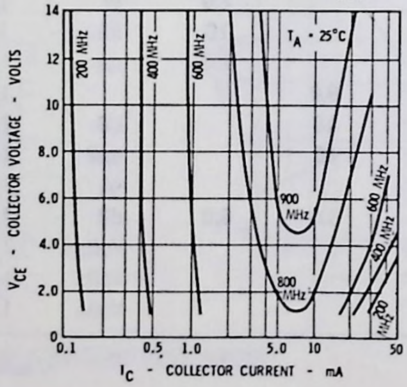

BASE SATURATION VOLTA
VERSUS COLLECTOR CURREN

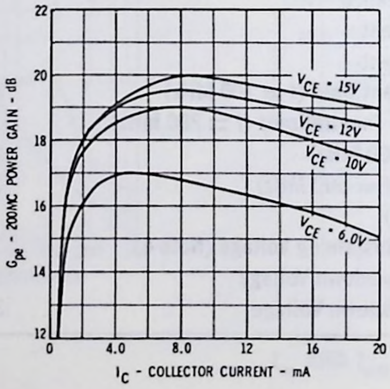

COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE

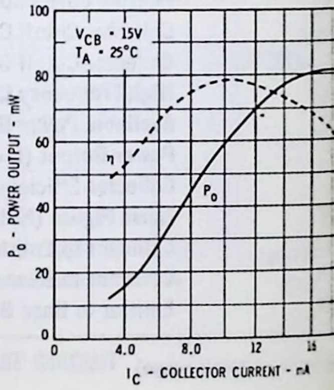

COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE


NOISE FIGURE VERSUS FREQUENCY


COLLECTOR-BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE


CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)


NEUTRALIZED 200 MHz POWER GAIN TYPICAL PERFORMANCE


500 MHz OSCILLATOR TYPICAL PERFORMANCE

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 625°C/Watt (derating factor of 1.6 mW/°C) when mounted to a printed circuit boa with a maximum lead length of 0.03 inch.

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) f = 60 MHz; $R_g = 400\ \Omega$.

(6) C_{cb} is measured using three terminal measurement technique with case and emitter guarded.

*Single family characteristics on Transistor Curve Tracer.

FX2368 • FX2369A

NPN HIGH SPEED SATURATED SWITCHES

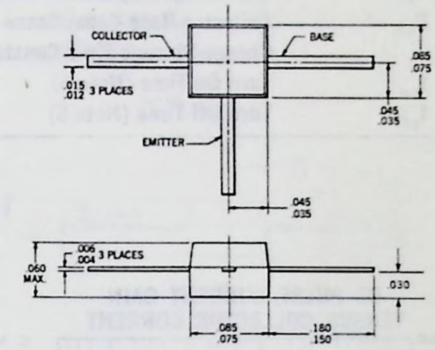
μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N2368 AND 2N2369A

SIMILAR TO 2N2368 AND 2N2369A
HIGH SPEED . . . . . . $\tau_S = 13$ **ns (MAX) AT 10 mA**
$t_{on} = 12$ **ns (MAX) AT 10 mA**
$t_{off} = 18$ **ns (MAX) AT 10 mA**
MEDIUM VOLTAGE . . . $LV_{CEO} = 15$ **V (MIN)**
HIGH FREQUENCY . . . $f_T = 500$ **MHz (MIN) AT 10 mA**
LOW CAPACITANCE . . . $C_{cb} = 4.0$ **pF (MAX) AT 5.0 V**

PHYSICAL DIMENSIONS

MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.240 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts
I_C	DC Collector Current	100 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FX2368			FX2369A					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	20	50	60	**40**	**66**	**120**		$I_C = 10$ mA	$V_{CE} = 1.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	10			20	50			$I_C = 10$ mA	$V_{CE} = 0.35$ V
$V_{BE(sat)}$	Base Saturation Voltage	0.7	0.8	0.85	0.7	0.8	0.85	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage (−55°C to +125°C)				0.59		1.02	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage					0.9	1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage					1.1	1.6	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (125°C)					0.19	0.3	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
I_{CES}	Collector Reverse Current			0.4		0.05	0.4	μA	$V_{BE} = 0$	$V_{CE} = 20$ V
$I_{CBO}(125°C)$	Collector Cutoff Current			30		10	30	μA	$I_E = 0$	$V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40			40			Volts	$I_C = 10$ μA	$I_E = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	15			**15**			**Volts**	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			4.5			Volts	$I_E = 10$ μA	$I_C = 0$

dditional Electrical Characteristics on Page 2
tes on Page 2

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

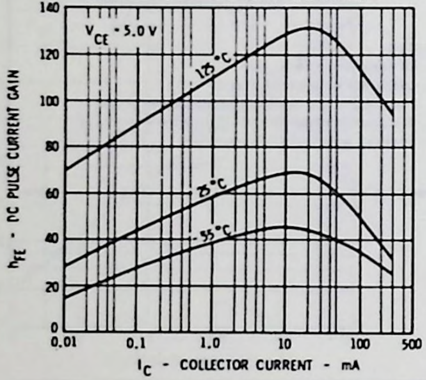
FAIRCHILD TRANSISTORS FX2368 • FX2369A

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

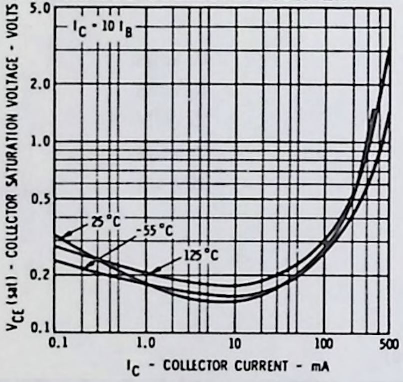
		FX2368			FX2369A					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)				40	63	120		$I_C = 10$ mA	$V_{CE} = 0.35$ V
h_{FE}	DC Pulse Current Gain (Note 5)				30	71			$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)				20				$I_C = 100$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	10							$I_C = 100$ mA	$V_{CE} = 2.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage		0.14	0.25		0.14	0.2	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage					0.17	0.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage					0.28	0.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	4.0	5.5		**5.0**	**6.75**			$I_C = 10$ mA	$V_{CE} = 10$ V
C_{cb}	**Collector-Base Capacitance**		2.3	4.0		**2.3**	**4.0**	pF	$I_E = 0$	$V_{CB} = 5.0$ V
τ_s	**Charge Storage Time Constant** (Note 6)		5.0	10		**6.0**	**13**	ns	$I_C = I_{B1} \approx 10$ mA,	$I_{B2} \approx -10$ mA
t_{on}	**Turn On Time** (Note 6)		9.0	12		**9.0**	**12**	ns	$I_C \approx 10$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	**Turn Off Time** (Note 6)		10	15		**1.3**	**18**	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA,	$I_{B2} \approx -1.5$ m

TYPICAL COLLECTOR AND BASE CHARACTERISTICS

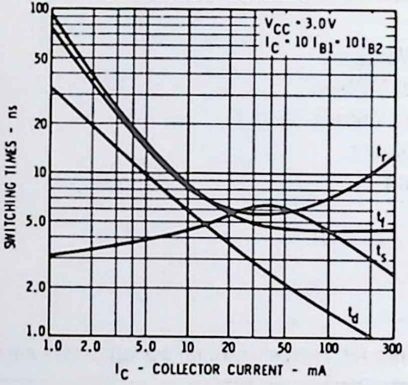
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



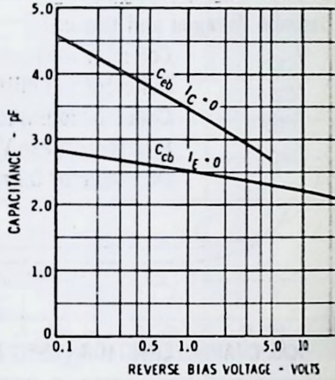
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

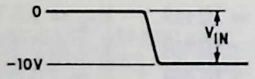


SWITCHING TIMES VERSUS COLLECTOR CURRENT

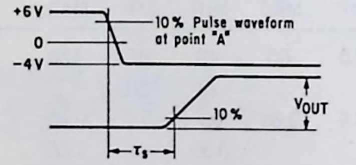


INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

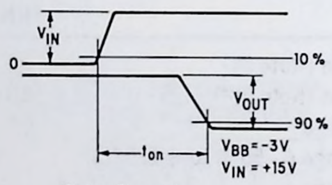




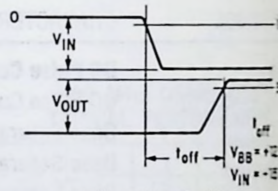
Pulse Generator
VIN Rise Time < 1 ns
Source Impedance = 50 Ω
PW ≥ 300 ns
Duty Cycle < 2%


+6V
0
-4V
10% Pulse waveform at point "A"
10%
V_{OUT}
τ_s

To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1 ns

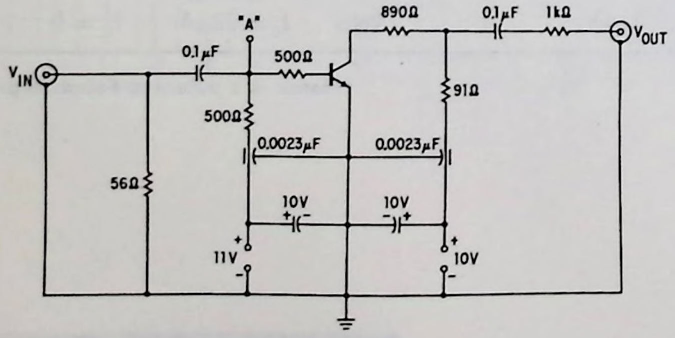

V_{IN}
0
10%
V_{OUT}
90%
t_{on}
V_{BB} = -3V
V_{IN} = +15V

Pulse Generator
VIN Rise Time < 1 ns
Source Impedance = 50 Ω
PW ≥ 300 ns
Duty Cycle < 2%

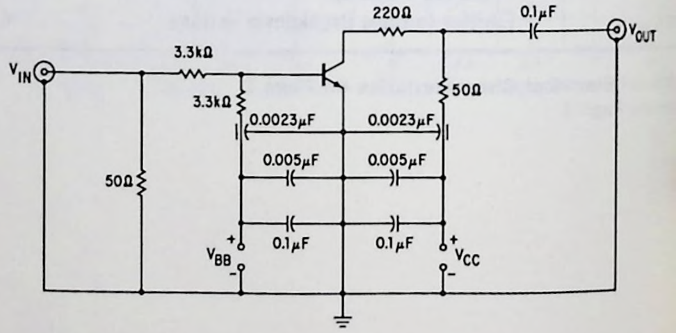

0
V_{IN}
V_{OUT}
t_{off}

To Sampling Oscilloscope
Input Impedance = 50 Ω
Rise Time ≤ 1 ns

CHARGE STORAGE TIME MEASUREMENT CIRCUIT


V_{IN}
0.1µF
"A"
500Ω
890Ω
0.1µF
1kΩ
V_{OUT}
91Ω
500Ω
0.0023µF
0.0023µF
56Ω
10V
10V
11V
10V

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT


V_{IN}
3.3kΩ
220Ω
0.1µF
V_{OUT}
3.3kΩ
50Ω
0.0023µF
0.0023µF
0.005µF
0.005µF
50Ω
0.1µF
0.1µF
V_{BB}
V_{CC}

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 625°C/Watt (derating factor of 1.6 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.
(4) Ratings refer to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 µs; duty cycle ≤ 2%.
(6) See switching circuits for exact value of I_C, I_{B1}, and I_{B2}.

FX2483 • FX2484

NPN LOW LEVEL, LOW NOISE TRANSISTORS

μPAK™ DIFFUSED SILICON PLANAR* TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N2483 AND 2N2484

- **SIMILAR TO 2N2483 AND 2N2484**
- **HIGH GAIN . . . . . $h_{FE} = 100\text{-}500$ AT 10 μA**
  $h_{FE} = 250$ (MIN) AT 1.0 mA
- **HIGH VOLTAGE . . . $LV_{CEO} = 60$ V (MIN)**
- **LOW NOISE . . . . . NF = 3.0 dB (MAX) AT 10 μA, 1.0 kHz**
  NF = 2.0 dB (MAX) AT 10 μA, 10 kHz

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

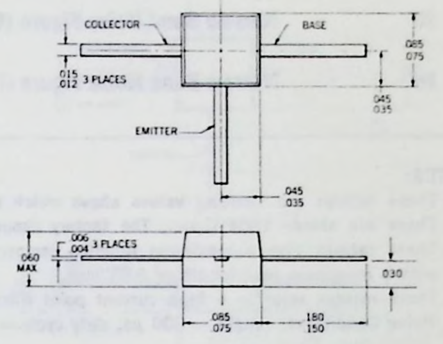
Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.270 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	50 mA

PHYSICAL DIMENSIONS
MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FX2483			FX2484					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)		280	500		430	800		$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{FE}	**DC Current Gain**	**175**	**230**		**250**	**450**			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	100	200		200	430			$I_C = 500$ μA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	75	140		175	375			$I_C = 100$ μA	$V_{CE} = 5.0$ V
h_{FE}	**DC Current Gain**	**40**	**80**	**120**	**100**	**290**	**500**		$I_C = 10$ μA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain				30	200			$I_C = 1.0$ μA	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Current Gain	10			20				$I_C = 10$ μA	$V_{CE} = 5.0$ V
$V_{BE(on)}$	Emitter-Base On Voltage	0.5	0.57	0.7	0.5	0.57	0.7	Volts	$I_C = 100$ μA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage		0.2	0.35		0.2	0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
h_{fe}	High Frequency Current Gain (f = 5.0 MHz)	2.4	4.0		3.0	4.0			$I_C = 50$ μA	$V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 30 MHz)	2.0	2.3		2.0	2.6			$I_C = 500$ μA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Cutoff Current		0.1	10		0.1	10	nA	$I_E = 0$	$V_{CB} = 45$ V
$I_{CBO}(125°C)$	Collector Cutoff Current		0.2	10		0.2	10	μA	$I_E = 0$	$V_{CB} = 45$ V
I_{EBO}	Emitter Cutoff Current		0.1	10		0.1	10	nA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEO}	Collector-Emitter Cutoff Current		0.1	2.0		0.1	2.0	nA	$I_B = 0$	$V_{CE} = 5.0$ V
C_{cb}	Collector-Base Capacitance		3.5	6.0		3.5	6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter-Base Capacitance		3.5	6.0		3.5	6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V

dditional Electrical Characteristics on Page 2
otes on Page 2

*Planar is a patented Fairchild process.

FAIRCHILD
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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

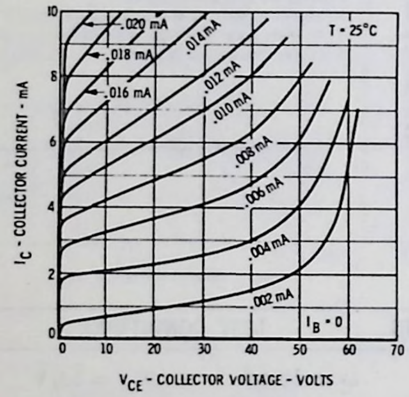
		FX2483			FX2484				
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			Volts	$I_C = 10\ \mu A$ $I_E = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**60**			**60**			**Volts**	$I_C = 10$ mA $I_B = 0$ (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$ $I_E = 10\ \mu A$
NF	**Wide Band Noise Figure (f = 10 Hz to 10 kHz)**		**1.9**	**4.0**		**1.8**	**3.0**	**dB**	$I_C = 10\ \mu A$, $V_{CE} = 5.0$ V, $R_S = 10$ kΩ
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**		**1.9**	**4.0**		**1.8**	**3.0**	**dB**	$I_C = 10\ \mu A$, $V_{CE} = 5.0$ V $R_S = 10$ kΩ, B.W. = 200 Hz
NF	**Narrow Band Noise Figure (f = 10 kHz)**		**0.7**	**3.0**		**0.6**	**2.0**	**dB**	$I_C = 10\ \mu A$, $V_{CE} = 5.0$ V $R_S = 10$ kΩ, B.W. = 2.0 kHz
NF	**Narrow Band Noise Figure (f = 100 Hz)**		**4.0**	**15**		**4.0**	**10**	**dB**	$I_C = 10\ \mu A$, $V_{CE} = 5.0$ V $R_S = 10$ kΩ, B.W. = 20 Hz

NOTES:

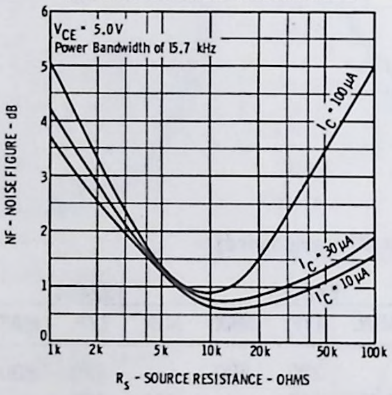
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 555°C/Watt (derating factor of 1.8 mW/°C) when mounted to a printed circuit boa with a maximum lead length of 0.03 inch.
(4) These ratings refer to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

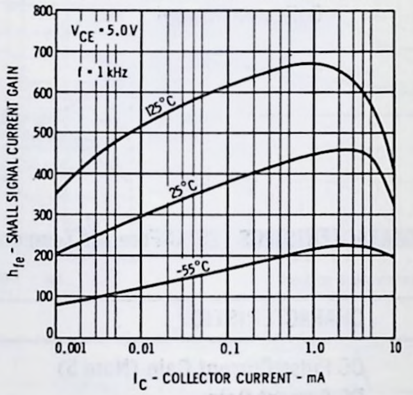
COLLECTOR CHARACTERISTICS*



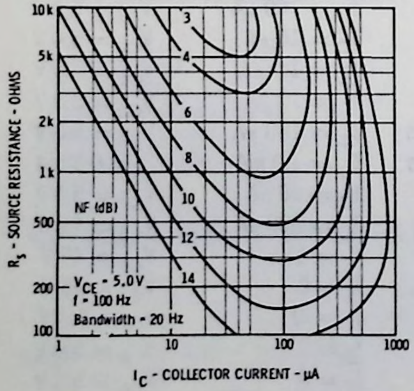
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



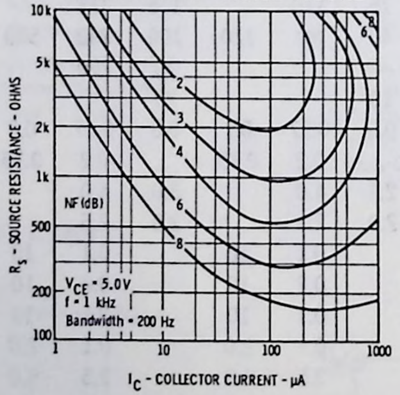
SMALL SIGNAL CURRENT GAIN VERSUS COLLECTOR CURRENT



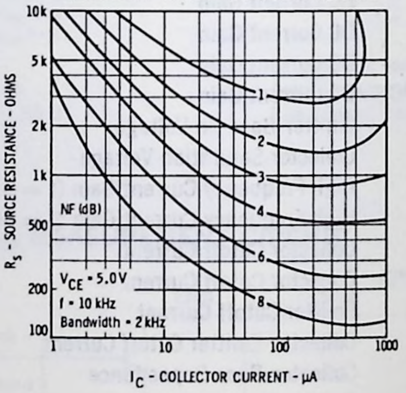
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



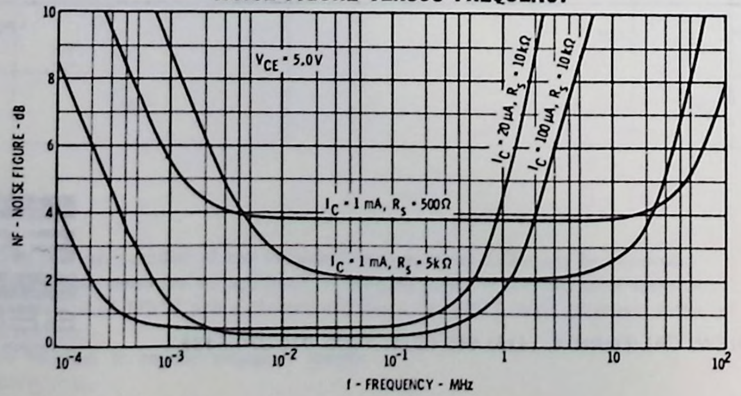
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



NOISE FIGURE VERSUS FREQUENCY



* Single family characteristics on Transistor Curve Tracer.

FX2894 • FX2894A

PNP HIGH SPEED SATURATED SWITCHES

μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N2894 • 2N2894A

SIMILAR TO 2N2894 AND 2N2894A

FAST SWITCHING . . . . t_{on} = 20 ns (MAX) AT 30 mA
t_{off} = 35 ns (MAX) AT 30 mA
τ_s = 40 ns (MAX) AT 10 mA
HIGH FREQUENCY . . . . f_T = 500 MHz (MIN) AT 15 mA
LOW CAPACITANCE . . . . C_{cb} = 4.5 pF (MAX)
LOW SATURATION VOLTAGE . . . $V_{CE(sat)}$ = 0.13 V (MAX) AT 10 mA

} **FX2894A**

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.240 Watt

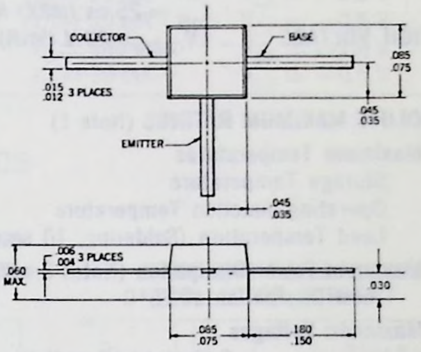
Maximum Voltages

		FX2894	FX2894A
V_{CBO}	Collector to Base Voltage	−12 Volts	−12 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−12 Volts	−12 Volts
V_{EBO}	Emitter to Base Voltage	−4.0 Volts	−4.5 Volts

PHYSICAL DIMENSIONS

MICRO-PACKAGE

In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

	CHARACTERISTIC	FX2894 MIN.	FX2894 TYP.	FX2894 MAX.	FX2894A MIN.	FX2894A TYP.	FX2894A MAX.	UNITS	TEST CONDITIONS	
t_{on}	**Turn On Time** (Note 6, Figure 1)					**10**	**20**	**ns**	**$I_C \approx 30$ mA**	**$I_{B1} \approx 3.0$ mA**
t_{off}	**Turn Off Time** (Note 6, Figure 1)					**15**	**35**	**ns**	**$I_C \approx 30$ mA**	**$I_{B1} \approx I_{B2} \approx 3.0$ mA**
t_{on}	Turn On Time (Note 6, Figure 2)		23	60				ns	$I_C \approx 30$ mA	$I_{B1} \approx 1.5$ mA
t_{off}	Turn Off Time (Note 6, Figure 2)		34	90				ns	$I_C \approx 30$ mA	$I_{B1} \approx I_{B2} \approx 1.5$ mA
τ_s	**Charge Storage Time Constant** (Note 6, Figure 3)					**15**	**40**	**ns**	**$I_C \approx I_{B1} \approx I_{B2} \approx 10$ mA**	
$V_{CE(sat)}$	**Pulsed Collector-Emitter Saturation Voltage** (Note 5)		**−0.07**	**−0.15**		**−0.08**	**−0.13**	**Volts**	**$I_C = 10$ mA**	**$I_B = 1.0$ mA**
$V_{CE(sat)}$	Pulsed Collector-Emitter Saturation Voltage (Note 5)		−0.10	−0.20		−0.12	−0.19	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE(sat)}$	Pulsed Collector-Emitter Saturation Voltage (Note 5)		−0.25	−0.50		−0.28	−0.45	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Pulsed Base-Emitter Saturation Voltage (Note 5)	−0.78	−0.82	−0.98	−0.78	−0.82	−0.92	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Pulsed Base-Emitter Saturation Voltage (Note 5)	−0.85	−1.10	−1.20	−0.85	−0.93	−1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{BE(sat)}$	Pulsed Base-Emitter Saturation Voltage (Note 5)		−1.40	−1.70	−0.95	−1.14	−1.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain** (f = 100 MHz)	**3.5**	**5.0**		**5.0**	**11**			**$I_C = 15$ mA**	**$V_{CE} = -10$ V**
C_{cb}	**Collector-Base Capacitance**		**3.3**	**6.0**		**3.3**	**4.5**	**pF**	**$I_E = 0$**	**$V_{CB} = -5.0$ V**
C_{eb}	Emitter-Base Capacitance		3.8	6.0		4.7	6.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
I_{CES}	Collector Reverse Current		0.05	80				nA	$V_{BE} = 0$	$V_{CE} = -6.0$ V
I_{CES}	Collector Reverse Current					0.29	50	nA	$V_{BE} = 0$	$V_{CE} = -10$ V

ditional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process.

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 175°C and a thermal resistance of 625°C/Watt (derating factor of 1.6 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.

This rating refers to a high current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD

SEMICONDUCTOR

A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FX3013 • FX3014

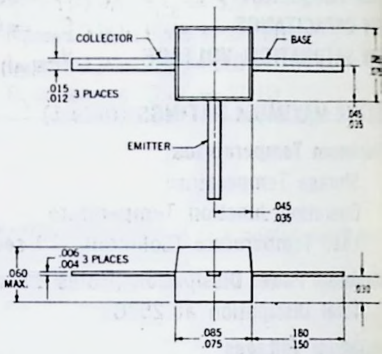
NPN HIGH SPEED SATURATED SWITCHES

μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N3013 •2N3014

- **SIMILAR TO 2N3013 AND 2N3014**
- **HIGH SPEED . . . . $\tau_s = 18$ ns (MAX) AT 10 mA**
  - **$t_{on} = 15$ ns (MAX) AT 300 mA (FX3013)**
  - **$t_{on} = 16$ ns (MAX) AT 30 mA (FX3014)**
  - **$t_{off} = 25$ ns (MAX) AT 300 mA (FX3013)**
  - **$t_{off} = 25$ ns (MAX) AT 30 mA (FX3014)**
- **HIGH VOLTAGE . . . $LV_{CEO} = 20$ V (MIN) (FX3014); 15 V (MIN) (FX3013)**

PHYSICAL DIMENSIONS
MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transter molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.260 Watt

Maximum Voltages

		FX3013	FX3014
V_{CBO}	Collector to Base Voltage	40 Volts	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts	20 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FX3014			FX3013					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	25	45						$I_C = 10$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60	120	30	60	120		$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)				25	55			$I_C = 100$ mA	$V_{CE} = 0.5$ V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55						$I_C = 100$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)				15	40			$I_C = 300$ mA	$V_{CE} = 1.0$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	12	30		12	30			$I_C = 30$ mA	$V_{CE} = 0.4$ V
$V_{CE(sat)}$	Collector Saturation Voltage		0.15	0.18					$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.16	0.18		0.16	0.18	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE(sat)}$(+125°C)	Collector Saturation Voltage		0.19	0.25		0.19	0.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.18	0.35		0.18	0.28	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{CE(sat)}$	Collector Saturation Voltage					0.39	0.5	Volts	$I_C = 300$ mA	$I_B = 30$ mA
$V_{BE(sat)}$	Base Saturation Voltage	0.70	0.75	0.80					$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage	0.75	0.82	0.95	0.75	0.82	0.95	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		0.97	1.2		0.97	1.2	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Base Saturation Voltage					1.3	1.7	Volts	$I_C = 300$ mA	$I_B = 30$ mA

Additional Electrical Characteristics on Page 2

*Planar is a patented Fairchild proces

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 576°C/Watt (derating factor of 1.74 mW/°C) when mounted to a printed circ board with a maximum lead length of 0.03 inch.
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD TRANSISTORS FX2894 • FX2894A

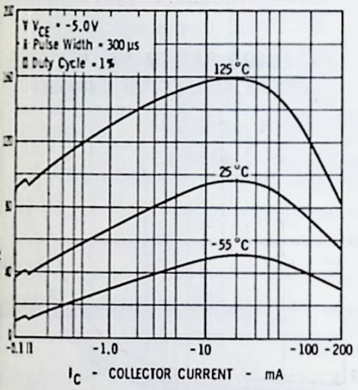
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FX2894 MIN.	FX2894 TYP.	FX2894 MAX.	FX2894A MIN.	FX2894A TYP.	FX2894A MAX.	UNITS	TEST CONDITIONS	
I_{CBO}(125°C)	Collector Cutoff Current			10				μA	$I_E = 0$	$V_{CB} = -6.0$ V
I_{CBO}(125°C)	Collector Cutoff Current					0.05	10	μA	$I_E = 0$	$V_{CB} = -10$ V
$BV_{CEO(sus)}$	**Collector-Emitter Sustaining Voltage (Notes 4 and 5)**	**—12**			**—12**			**Volts**	**$I_C = 10$ mA (pulsed)**	**$I_B = 0$**
BV_{CBO}	Collector-Base Breakdown Voltage	−12			−12			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector-Emitter Breakdown Voltage	−12			−12			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{EBO}	Emitter Base Breakdown Voltage	−4.0			−4.5			Volts	$I_C = 0$	$I_E = 100$ μA
h_{FE}	DC Pulse Current Gain (Note 5)				20	44			$I_C = 1.0$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55		30				$I_C = 10$ mA	$V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	75	120	40	63	120		$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	**DC Pulse Current Gain (Note 5)**	**20**			**30**	**55**			**$I_C = 100$ mA**	**$V_{CE} = -1.0$ V**
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	12	40		20	40			$I_C = 30$ mA	$V_{CE} = -0.5$ V

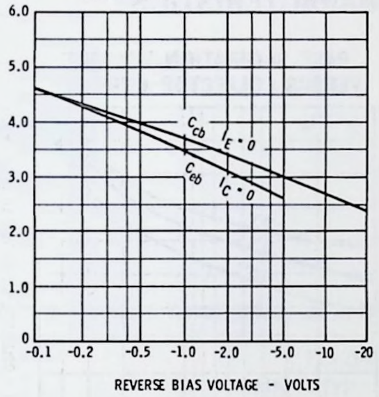
TYPICAL COLLECTOR AND BASE CHARACTERISTICS

FX2894

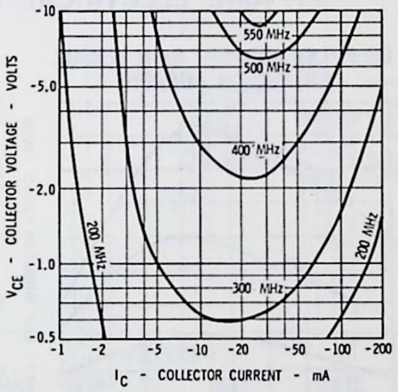
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



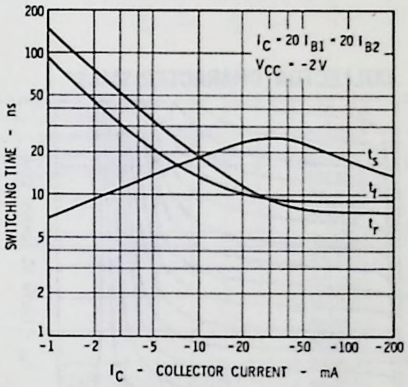
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

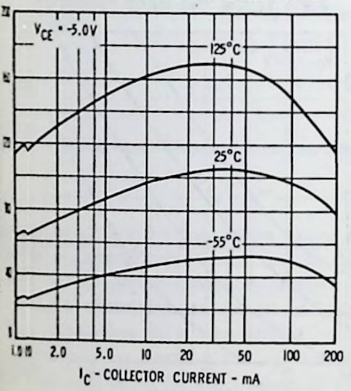


SWITCHING TIMES VERSUS COLLECTOR CURRENT

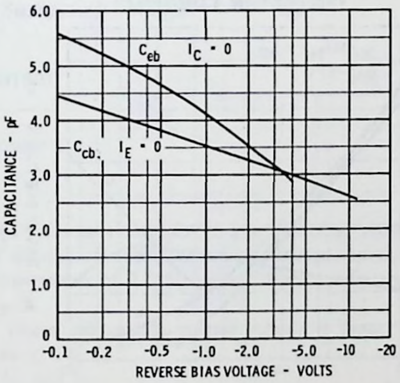


FX2894A

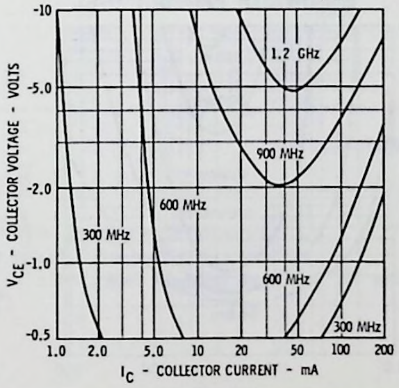
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



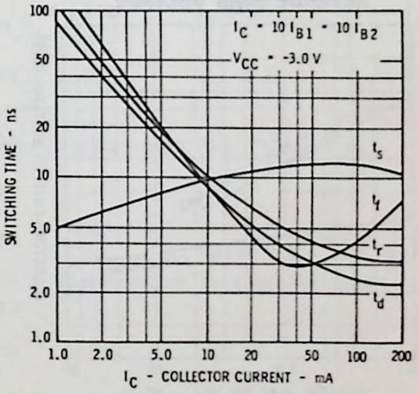
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

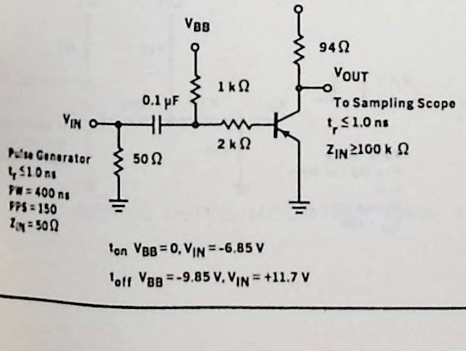


SWITCHING TIMES VERSUS COLLECTOR CURRENT

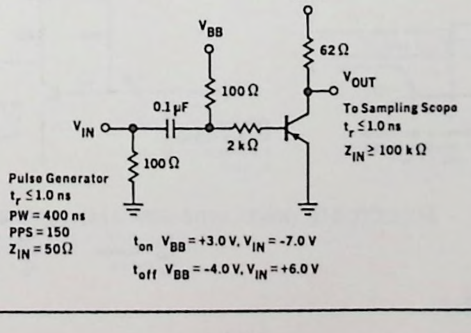


FX2894 • FX2894A

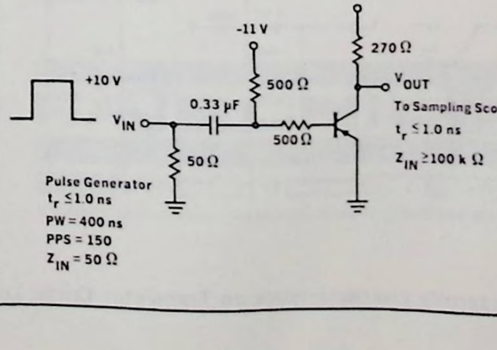
SWITCHING TIME TEST CIRCUIT FIGURE 1


-3.0 V
V_{BB}
94Ω
V_{OUT}
1 kΩ
0.1 μF
To Sampling Scope
t_r ≤1.0 ns
Z_{IN} ≥100 k Ω
V_{IN}
2 kΩ
50Ω
Pulse Generator
t_r ≤1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50Ω
t_{on} V_{BB} = 0, V_{IN} = -6.85 V
t_{off} V_{BB} = -9.85 V, V_{IN} = +11.7 V

SWITCHING TIME TEST CIRCUIT FIGURE 2


-2.0 V
V_{BB}
62Ω
V_{OUT}
100Ω
0.1μF
To Sampling Scope
t_r ≤1.0 ns
Z_{IN} ≥ 100 k Ω
V_{IN}
2 kΩ
100Ω
Pulse Generator
t_r ≤1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50Ω
t_{on} V_{BB} = +3.0 V, V_{IN} = -7.0 V
t_{off} V_{BB} = -4.0 V, V_{IN} = +6.0 V

SWITCHING TIME TEST CIRCUIT FIGURE 3


-3.0 V
-11 V
270 Ω
+10 V
500 Ω
V_{OUT}
0.33 μF
To Sampling Scope
t_r ≤ 1.0 ns
Z_{IN} ≥100 k Ω
V_{IN}
500Ω
50 Ω
Pulse Generator
t_r ≤1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω

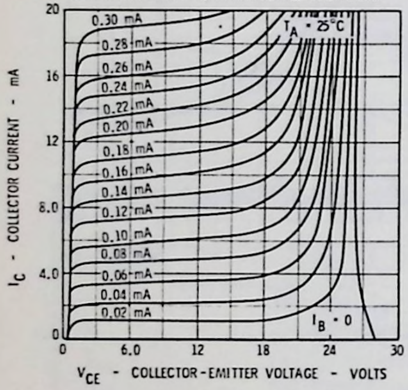
FAIRCHILD TRANSISTOR FX3013 • FX3014

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

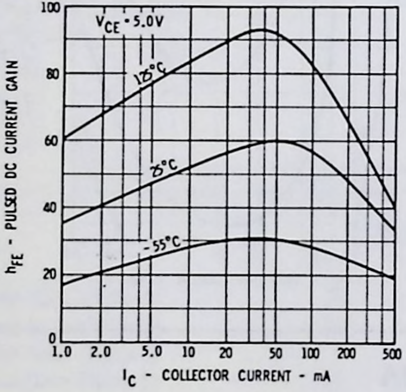
SYMBOL	CHARACTERISTIC	FX3014 MIN.	FX3014 TYP.	FX3014 MAX.	FX3013 MIN.	FX3013 TYP.	FX3013 MAX.	UNITS	TEST CONDITIONS	
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	5.5		3.5	5.5			$I_C = 15$ mA	$V_{CE} = 10$ V
C_{cb}	Collector-Base Capacitance		3.3	5.0		3.3	5.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter-Base Capacitance		6.5	8.0		6.5	8.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CES}	Collector Reverse Current		0.04	0.3		0.04	0.3	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CES}(125°C)	Collector Reverse Current		2.0	40		2.0	40	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40			40			Volts	$I_C = 100$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	40			40			Volts	$I_C = 100$ μA	$I_E = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**20**			**15**			**Volts**	**$I_C = 10$ mA** (pulsed)	**$I_B = 0$**
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_E = 100$ μA	$I_C = 0$
τ_s	Charge Storage Time Constant (Note 6)		8.0	18		8.0	18	ns	$I_C = I_{B1} \approx 10$ mA,	$I_{B2} \approx -10$ mA
t_{on}	**Turn On Time** (Note 6)		**11**	**16**				**ns**	**$I_C \approx 30$ mA,**	**$I_{B1} \approx 3.0$ mA**
t_{off}	**Turn Off Time** (Note 6)		**16**	**25**				**ns**	**$I_C \approx 30$ mA, $I_{B1} \approx 3.0$ mA**	**$I_{B2} \approx -3.0$ mA**
t_{on}	**Turn On Time** (Note 6)					**9.0**	**15**	**ns**	**$I_C \approx 300$ mA,**	**$I_{B1} \approx 30$ mA**
t_{off}	**Turn Off Time** (Note 6)					**15**	**25**	**ns**	**$I_C \approx 300$ mA, $I_{B1} \approx 30$ mA**	**$I_{B2} \approx -3.0$ mA**

TYPICAL ELECTRICAL CHARACTERISTICS

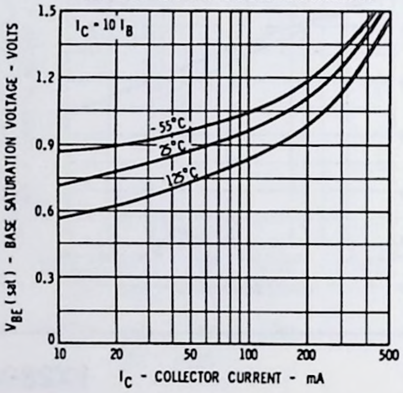
COLLECTOR CHARACTERISTICS*



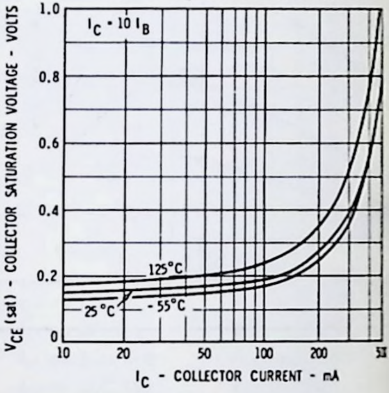
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



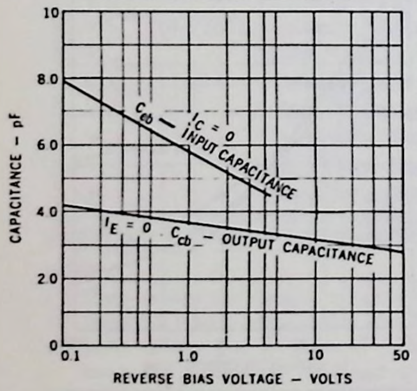
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



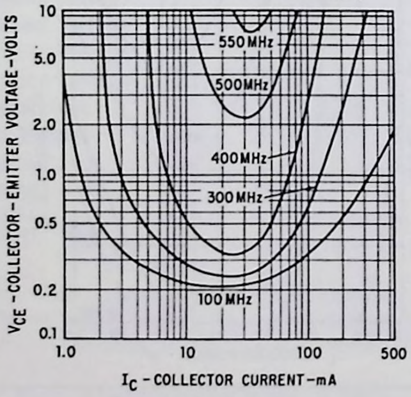
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



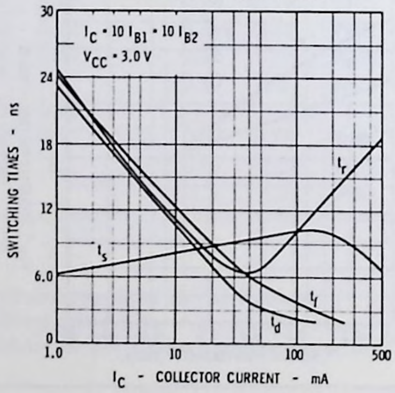
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



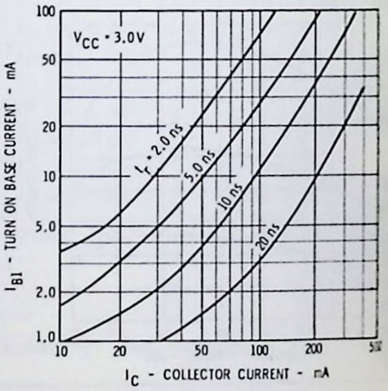
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



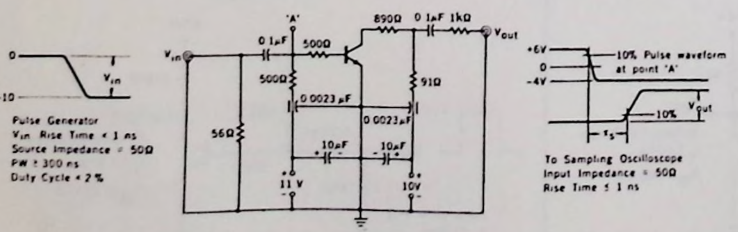
SWITCHING TIMES VERSUS COLLECTOR CURRENT



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



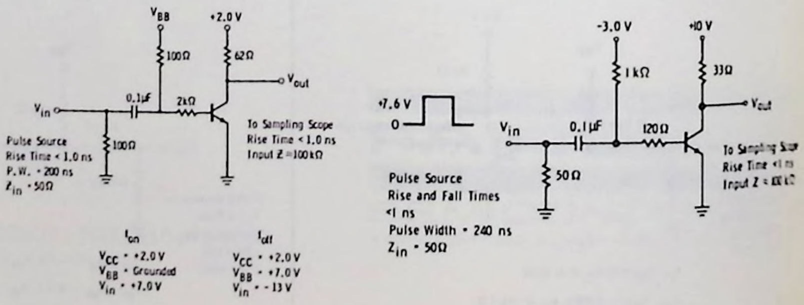
CHARGE STORAGE TIME MEASUREMENT CIRCUIT



Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

t_{on} AND t_{off} TEST CIRCUIT



Pulse Source
Rise Time < 1.0 ns
P.W. = 200 ns
Z_{in} = 50Ω

To Sampling Scope
Rise Time < 1.0 ns
Input Z = 100 kΩ

t_{on}
V_{CC} = +2.0 V
V_{BB} = Grounded
V_{in} = +7.0 V

t_{off}
V_{CC} = +2.0 V
V_{BB} = +7.0 V
V_{in} = -13 V

Pulse Source
Rise and Fall Times
<1 ns
Pulse Width = 240 ns
Z_{in} = 50Ω

To Sampling Sco
Rise Time <1 ns
Input Z = 100 k

* Single family characteristics on Transistor Curve Tracer.

FX3299 • FX3300

NPN RF AMPLIFIERS AND HIGH SPEED SWITCHES

μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N3299 • 2N3300

SIMILAR TO 2N3299 AND 2N3300

IGH FREQUENCY . . . . $f_T = 250$ MHz (MIN)

IGH SPEED . . . . $t_{on} = 60$ ns (MAX) AT 300 mA

$t_{off} = 160$ ns (MAX) AT 300 mA

OW SATURATION VOLTAGE . . . $V_{CE(sat)} = 0.22$ V (MAX) AT 150 mA

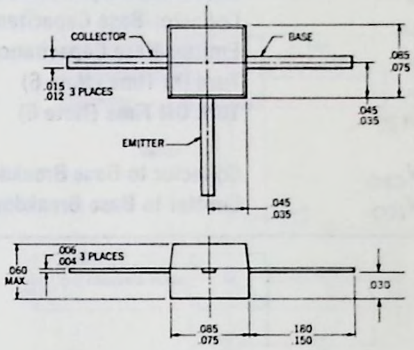
$V_{CE(sat)} = 0.75$ V (MAX) AT 500 mA

EDIUM VOLTAGE . . . . $LV_{CEO} = 30$ V (MIN)

PHYSICAL DIMENSIONS

MICRO-PACKAGE

In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

OLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +175°C
Operating Junction Temperature		+175°C
Lead Temperature (Soldering, 10 second time limit)		+260°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C		0.270 Watt
Maximum Voltage and Current		
V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FX3299			FX3300					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	75	120	100	220	300		$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	20	40		35	80			$I_C = 100$ μA	$V_{CE} = 10$ V
$V_{CE(sat)}$	**Collector Saturation Voltage** (Note 5)		**0.4**	**0.75**		**0.4**	**0.75**	**Volts**	**$I_C = 500$ mA**	**$I_B = 50$ mA**
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		1.1	1.5		1.1	1.5	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**30**			**30**			**Volts**	$I_C = 10$ mA (pulsed)	$I_B = 0$
I_{CES}	Collector Reverse Current		0.2	10		0.2	10	nA	$V_{CE} = 50$ V	$V_{EB} = 0$

tional Electrical Characteristics on page 2

*Planar is a patented Fairchild process.

S:

hese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

hese are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

hese ratings give a maximum junction temperature of 175°C and a thermal resistance of 555°C/Watt (derating factor of 1.8 mW/°C) when mounted to a printed circuit oard with a maximum lead length of 0.03 inch.

his rating refers to a high-current point where collector to emitter voltage is lowest.

ulse Conditions: length = 300 μs; duty cycle ≤ 2%.

ee switching circuit for exact values of I_C, I_{B1} and I_{B2}.

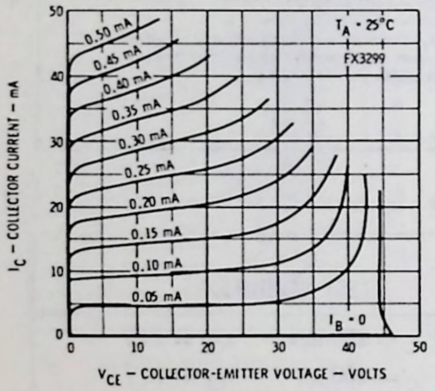
FAIRCHILD TRANSISTORS FX3299 • FX3300

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

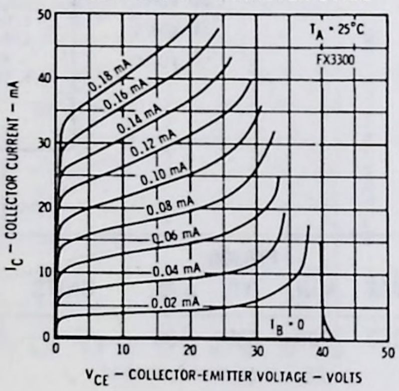
SYMBOL	CHARACTERISTIC	FX3299 MIN.	FX3299 TYP.	FX3299 MAX.	FX3300 MIN.	FX3300 TYP.	FX3300 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	35	70		75	205			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	25	58		50	140			$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	50		50	75			$I_C = 150$ mA	$V_{CE} = 1.0$ V
$V_{CE(sat)}$	**Collector Saturation Voltage**		**0.14**	**0.22**		**0.14**	**0.22**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
$V_{BE(sat)}$	Base Saturation Voltage		0.9	1.1		0.9	1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
I_{CES}(125°C)	Collector Reverse Current		0.2	10		0.2	10	μA	$V_{CE} = 50$ V	$V_{EB} = 0$
I_{EBO}	Emitter Cutoff Current		0.1	10		0.1	10	nA	$I_C = 0$	$V_{EB} = 3.0$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**2.0**	**3.0**		**2.5**	**3.0**			**$I_C = 20$ mA**	**$V_{CE} = 5.0$ V**
C_{cb}	Collector-Base Capacitance		6.0	8.0		6.0	8.0	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		14	20		14	20	pF	$I_C = 0$	$V_{EB} = 2.0$ V
t_{on}	**Turn On Time** (Note 6)		**14**	**60**		**14**	**60**	ns	**$I_C \approx 300$ mA,**	**$I_{B1} \approx 30$ mA**
t_{off}	**Turn Off Time** (Note 6)		**80**	**160**		**80**	**160**	ns	**$I_C \approx 300$ mA,**	**$I_{B1} \approx 30$ mA,** **$I_{B2} \approx -30$ mA**
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_E = 10$ μA	$I_C = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

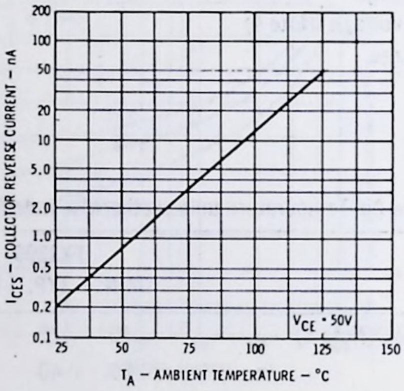
COLLECTOR CHARACTERISTICS*



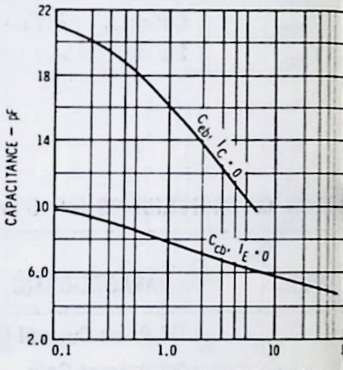
COLLECTOR CHARACTERISTICS*



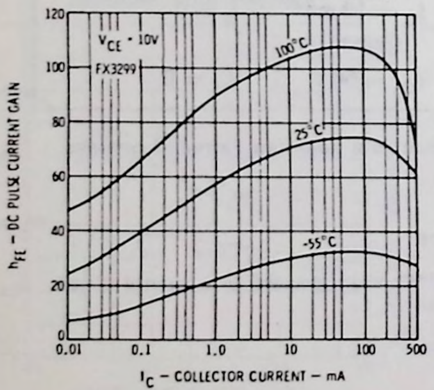
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



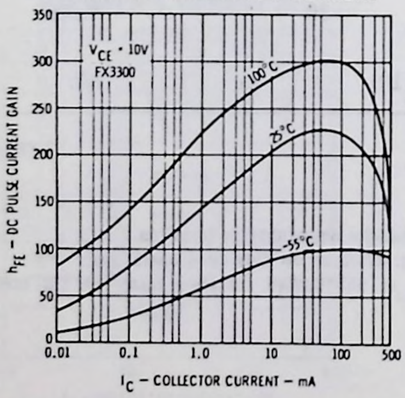
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



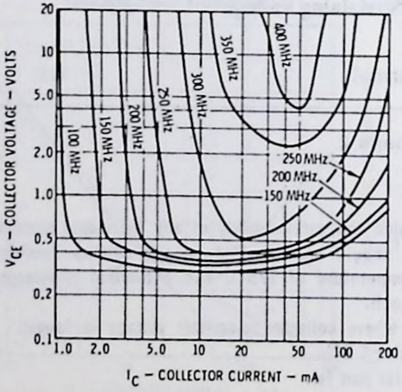
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



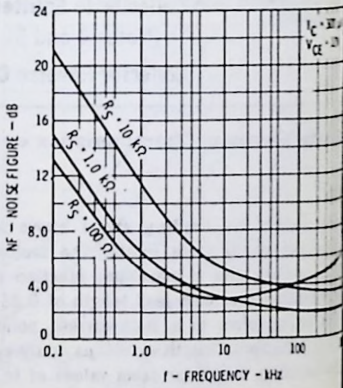
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



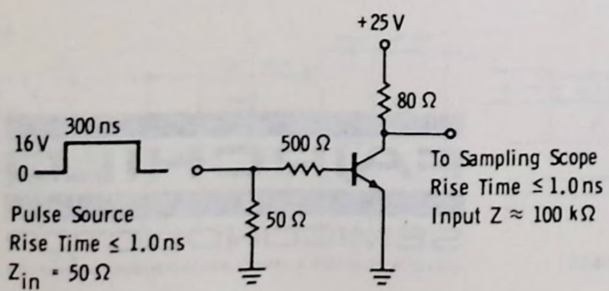
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



NOISE FIGURE VERSUS FREQUENCY

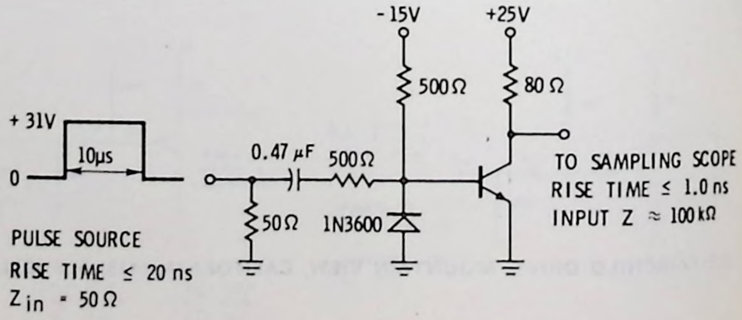


t_{on} TEST CIRCUIT



+25 V
80 Ω
300 ns
16 V
0
500 Ω
50 Ω
To Sampling Scope
Rise Time ≤ 1.0 ns
Input Z ≈ 100 kΩ
Pulse Source
Rise Time ≤ 1.0 ns
Z_{in} = 50 Ω

t_{off} TEST CIRCUIT



-15V
+25V
500 Ω
80 Ω
+31V
10μs
0
0.47 μF
500 Ω
50 Ω
1N3600
TO SAMPLING SCOPE
RISE TIME ≤ 1.0 ns
INPUT Z ≈ 100 kΩ
PULSE SOURCE
RISE TIME ≤ 20 ns
Z_{in} = 50 Ω

* Single family characteristics on Transistor Curve Tracer.

FX3502 • FX3503

PNP HIGH CURRENT SWITCHES

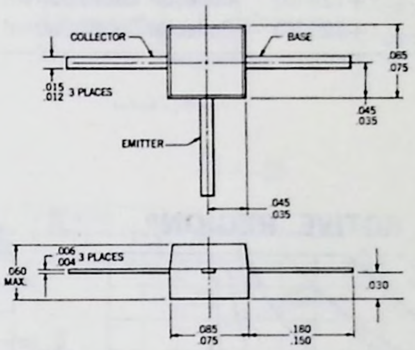
μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N3502 • 2N3503

IMILAR TO 2N3502 AND 2N3503
IGH VOLTAGE . . . . LV_{CEO} = 45 V (MIN) (FX3502); 60 V (MIN) (FX3503)
IGH GAIN . . . . h_{FE} = 100 (MIN) AT 1 mA, 10 mA AND 150 mA
EDIUM SPEED . . . . t_{on} = 40 ns (MAX) AT 300 mA
t_{off} = 100 ns (MAX) AT 300 mA
OW SATURATION VOLTAGE . . . $V_{CE(sat)}$ = 0.25 V (MAX) AT 50 mA
$V_{CE(sat)}$ = 0.4 V (MAX) AT 150 mA

PHYSICAL DIMENSIONS

MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transter molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

OLUTE MAXIMUM RATINGS (Note 1)

laximum Temperatures

Storage Temperature			−65°C to +175°C
Operating Junction Temperature			+175°C
Lead Temperature (Soldering, 10 second time limit)			+260°C

laximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C			0.270 Watt

laximum Voltages and Current

		FX3502	FX3503
V_{CBO}	Collector to Base Voltage	−45 Volts	−60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−45 Volts	−60 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C	Collector Current (Note 2)	500 mA	500 mA

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	FX3502 MIN.	FX3502 TYP.	FX3502 MAX.	FX3503 MIN.	FX3503 TYP.	FX3503 MAX.	UNITS	TEST CONDITIONS	
FE	DC Current Gain	75			75				I_C = 100 μA	V_{CE} = −10 V
FE	**DC Current Gain**	**100**	**200**		**100**	**200**			**I_C = 1.0 mA**	**V_{CE} = −10 V**
FE	**DC Pulse Current Gain** (Note 5)	**100**	**270**		**100**	**270**			**I_C = 10 mA**	**V_{CE} = −10 V**
FE	**DC Pulse Current Gain** (Note 5)	**100**	**150**	**300**	**100**	**150**	**300**		**I_C = 150 mA**	**V_{CE} = −10 V**
FE	DC Pulse Current Gain	115	160	300	115	160	300		I_C = 50 mA	V_{CE} = −1.0 V
BE(sat)	Base Saturation Voltage (see Note 5)		−0.9	−1.0		−0.9	−1.0	Volts	I_C = 50 mA (pulsed)	I_B = 2.5 mA
BE(sat)	Base Saturation Voltage (see Note 5)		−1.0	−1.3		−1.0	−1.3	Volts	I_C = 150 mA (pulsed)	I_B = 15 mA
CE(sat)	**Collector Saturation Voltage** (see Note 5)		**−0.08**	**−0.25**		**−0.08**	**−0.25**	**Volts**	**I_C = 50 mA (pulsed)**	**I_B = 2.5 mA**
CE(sat)	**Collector Saturation Voltage** (see Note 5)		**−0.18**	**−0.4**		**−0.18**	**−0.4**	**Volts**	**I_C = 150 mA (pulsed)**	**I_B = 15 mA**
fe	High Frequency Current Gain (f = 100 MHz)	1.5	2.5		1.5	2.5			I_C = 10 mA (pulsed)	V_{CE} = −15 V
CEO(sus)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**−45**			**−60**			**Volts**	**I_C = 10 mA (pulsed)**	**I_B = 0**
on	**Turn On Time** (Note 6)		**20**	**40**		**20**	**40**	**ns**	**I_C ≈ 300 mA**	**I_{B1} ≈ 30 mA**
off	**Turn Off Time** (Note 6)		**40**	**100**		**40**	**100**	**ns**	**I_C ≈ 300 mA,**	**I_{B1} ≈ 30 mA, I_{B2} ≈ −30 mA**

tional Electrical Characteristics on Page 2
s on Page 2

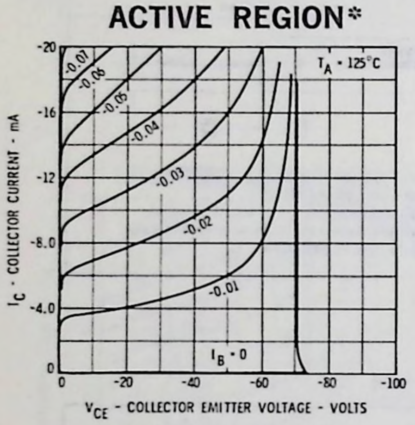
*Planar is a patented Fairchild process.

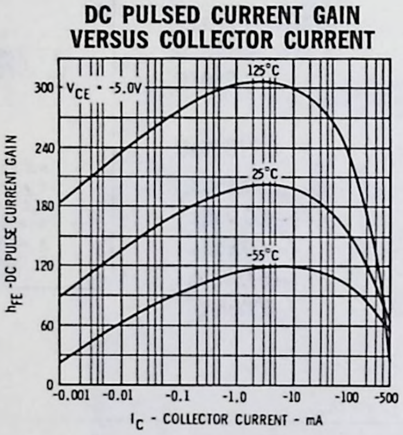
FAIRCHILD TRANSISTORS FX3502 • FX3503

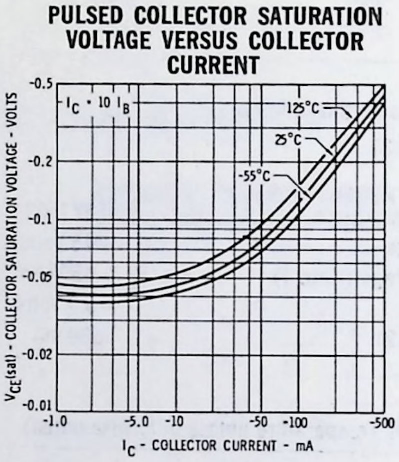
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

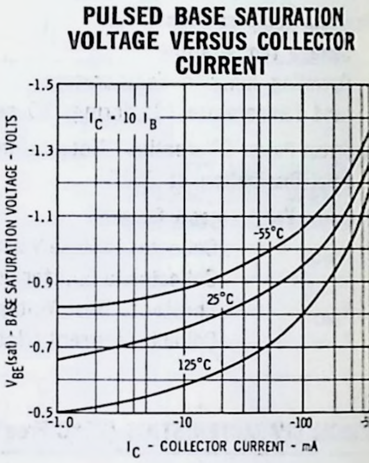
SYMBOL	CHARACTERISTIC	FX3502 MIN.	FX3502 TYP.	FX3502 MAX.	FX3503 MIN.	FX3503 TYP.	FX3503 MAX.	UNITS	TEST CONDITIONS	
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	50	100		50	100			$I_C = 50$ mA	$V_{CE} = -1.0$ V
I_{CES}	Collector Reverse Current					0.07	10	nA	$V_{CE} = -50$ V	$V_{BE} = 0$
I_{CES}	Collector Reverse Current		0.05	10				nA	$V_{CE} = -30$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−45			−60			Volts	$I_C = 10\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			Volts	$I_E = 10\ \mu A$	$I_C = 0$
C_{cb}	Collector-Base Capacitance		4.5	8.0		4.5	8.0	pF	$I_E = 0$	$V_{CB} = -10$ V
C_{eb}	Emitter-Base Capacitance		15	30		15	30	pF	$I_C = 0$	$V_{EB} = -0.5$ V
$I_{CBO}(+125°C)$	Collector Cutoff Current						10	μA	$V_{CB} = -50$ V	$I_E = 0$
$I_{CBO}(+125°C)$	Collector Cutoff Current			10				μA	$V_{CB} = -30$ V	$I_E = 0$

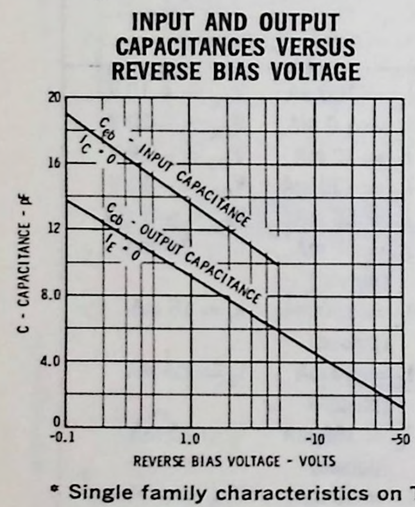
TYPICAL ELECTRICAL CHARACTERISTICS

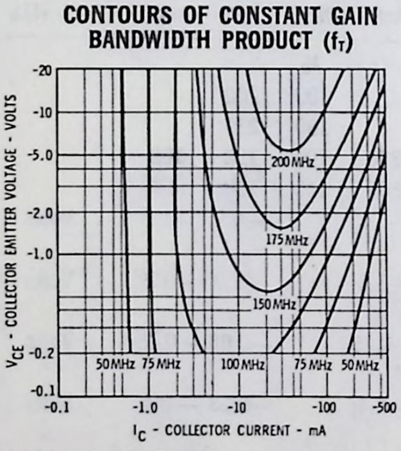

ACTIVE REGION*

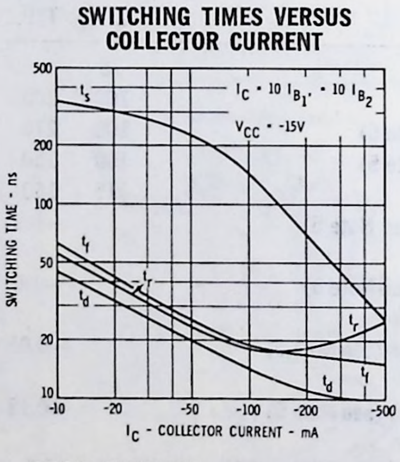

DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT

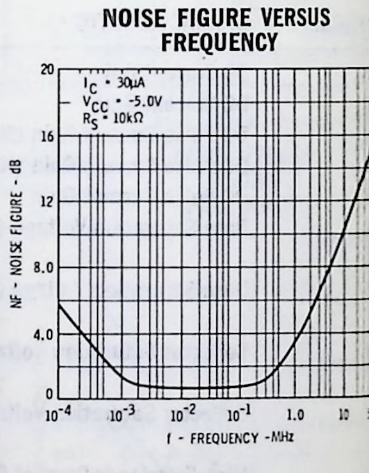

PULSED COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT


PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT


INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

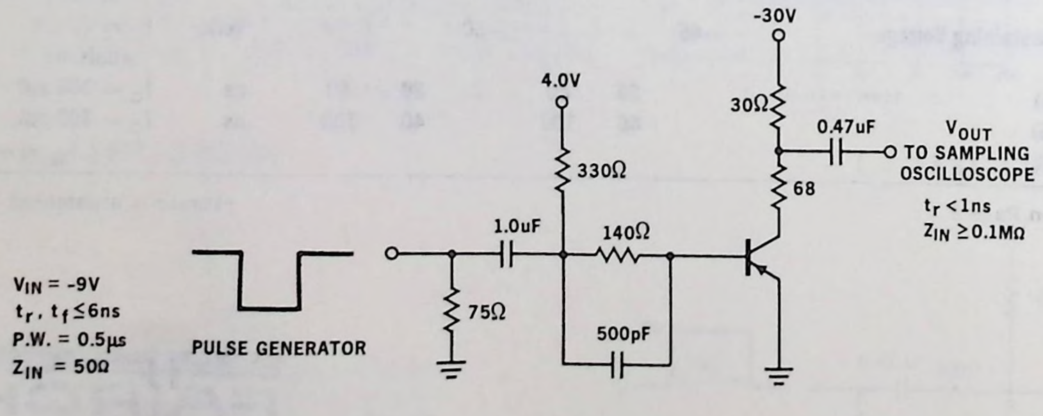

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)


SWITCHING TIMES VERSUS COLLECTOR CURRENT


NOISE FIGURE VERSUS FREQUENCY

* Single family characteristics on Transistor Curve Tracer.

t_{ON} and t_{OFF} TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 555°C/Watt (derating factor of 1.8 mW/°C) when mounted to a printed circuit boa with a maximum lead length of 0.03 inch.

(4) This rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

FX3724 • FX3725

NPN HIGH-VOLTAGE, HIGH-CURRENT SWITCHES

μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N3724 • 2N3725

SIMILAR TO 2N3724 AND 2N3725

HIGH SPEED . . . . $t_{on} = 35$ ns (MAX) AT 500 mA
$t_{off} = 60$ ns (MAX) AT 500 mA

HIGH VOLTAGE . . . . $LV_{CEO} = 50$ V (MIN) (FX3725)

LOW SATURATION VOLTAGE . . . $V_{CE(sat)} = 1.0$ V (MAX) AT 1.0 A (FX3725)
$V_{CE(sat)} = 0.6$ V (MAX) AT 500 mA (FX3725)

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature −65°C to +175°C
Operating Junction Temperature +175°C
Lead Temperature (Soldering, 10 second time limit) +260°C

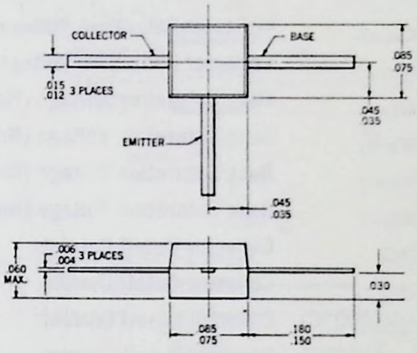
Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C 0.306 Watt

Maximum Voltages and Current

		FX3724	FX3725
V_{CBO}	Collector to Base Voltage	50 Volts	80 Volts
V_{CES}	Collector to Emitter Voltage	50 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	Maximum Collector Current (Note 5)	1.0 Amp	1.0 Amp

PHYSICAL DIMENSIONS
MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transter molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FX3724 MIN.	FX3724 TYP.	FX3724 MAX.	FX3725 MIN.	FX3725 TYP.	FX3725 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	30			50			Volt	$I_C = 10$ mA (pulsed)	$I_B = 0$
$V_{CE(sat)}$	**Collector Saturation Voltage** (pulsed, see Note 5)		0.5	0.9		0.6	1.0	Volt	$I_C = 1000$ mA	$I_B = 100$ mA
$V_{CE(sat)}$	**Collector Saturation Voltage** (pulsed, see Note 5)		0.3	0.55		0.4	0.6	Volt	$I_C = 500$ mA	$I_B = 50$ mA
t_{on}	**Turn-on Time** (Note 6)		18	35		18	35	ns	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA
t_{off}	**Turn-off Time** (Note 6)		45	60		45	60	ns	$I_C \approx 500$ mA,	$I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.4			2.4				$I_C = 30$ mA	$V_{CE} = 5.0$ V
C_{cbo}	Collector-Base Capacitance		6.0	12		4.8	10	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{ebo}	Emitter-Base Capacitance		40	55		40	55	pF	$I_C = 0$	$V_{BE} = 0.5$ V

tional Electrical Characteristics on Page 2
es on Page 2

*Planar is a patented Fairchild process.

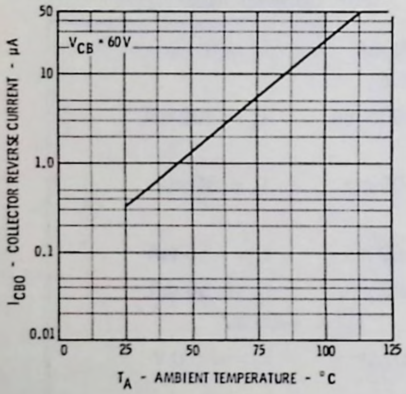
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

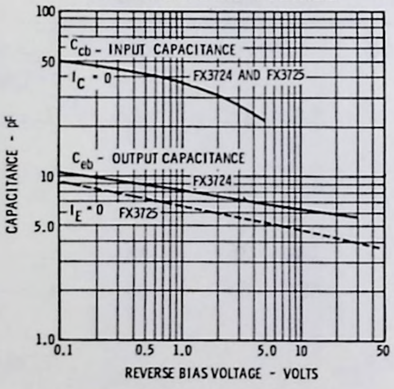
		FX3724			FX3725					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	60	90	150	60	90	150		$I_C = 100$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	35	50		35	45			$I_C = 500$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	65		25	65			$I_C = 1000$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60		30	60			$I_C = 10$ mA	$V_{CE} = 1.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	30	45		30	40			$I_C = 100$ mA	$V_{CE} = 1.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	20	40		20	35			$I_C = 500$ mA	$V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.11	0.30		0.19	0.30	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.13	0.2		0.21	0.26	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.64	0.8		0.64	0.8	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.75	0.86		0.75	0.86	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.95	1.3		0.95	1.3	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		1.1	1.8		1.1	1.8	Volts	$I_C = 1000$ mA	$I_B = 100$ mA
I_{CBO}	Collector Cutoff Current		0.25	1.7				μA	$I_E = 0$	$V_{CB} = 40$ V
I_{CBO}	Collector Cutoff Current					0.33	1.7	μA	$I_E = 0$	$V_{CB} = 60$ V
$I_{CBO}(100°C)$	Collector Cutoff Current		25	120				μA	$I_E = 0$	$V_{CB} = 40$ V
$I_{CBO}(100°C)$	Collector Cutoff Current					25	120	μA	$I_E = 0$	$V_{CB} = 60$ V
BV_{CBO}	Collector to Base Breakdown Voltage	50			80			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	50			80			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 10$ μA

TYPICAL ELECTRICAL CHARACTERISTICS

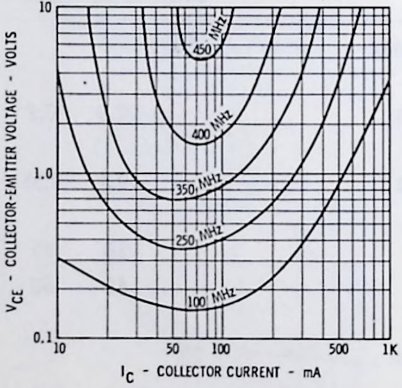
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



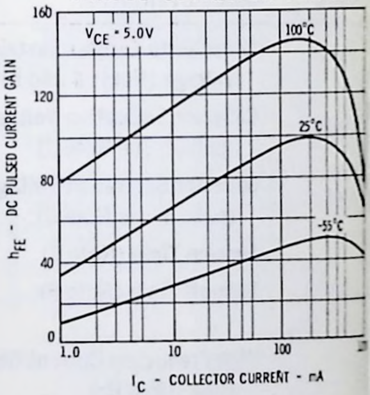
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



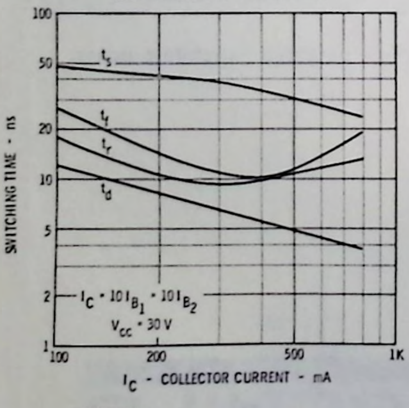
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



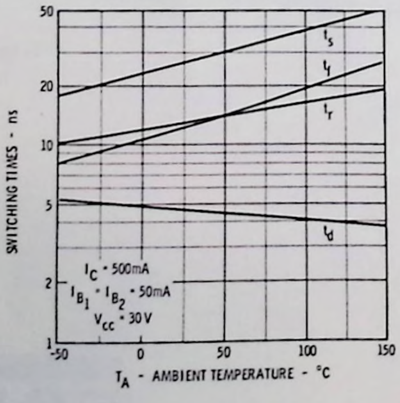
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



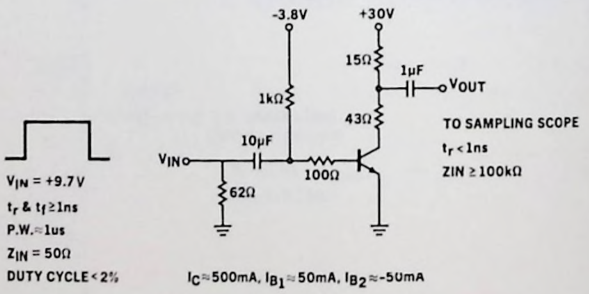
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 490°C/Watt (derating factor of 2.04 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.

(4) Ratings refer to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) See switching circuit for exact value of I_C, I_{B1}, and I_{B2}.

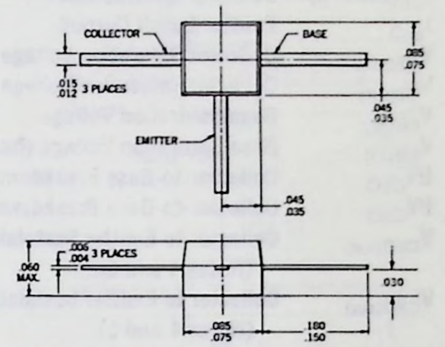
FX3962 • FX3963 • FX3964 • FX3965

PNP LOW LEVEL, LOW NOISE DEVICES

μPAK™ DIFFUSED SILICON PLANAR* TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N3962 THRU 2N3965

IMILAR TO 2N3962 THRU 2N3965
OW NOISE . . . . . NF = 2.0 dB (MAX) WIDEBAND
NF = 2.0 dB (MAX) AT 1.0 AND 10 kHz
NF = 4.0 dB (MAX) AT 100 Hz
IGH VOLTAGE . . . LV_{CEO} = 45 TO 80 V (MIN)
IGH GAIN . . . . . h_{FE} = 250-500 FROM 10μA TO 1.0mA
OOD h_{FE} LINEARITY FROM 10 μA TO 50 mA


PHYSICAL DIMENSIONS

MICRO-PACKAGE

In accordance with JEDEC TO-120

NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

OLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.270 Watt

Maximum Voltages

		FX3962 FX3965	FX3963	FX3964
V_{CBO}	Collector to Base Voltage	−60 Volts	−80 Volts	−45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−60 Volts	−80 Volts	−45 Volts
V_{EBO}	Emitter to Base Voltage	−6.0 Volts	−6.0 Volts	−6.0 Volts

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	FX3962 FX3963 MIN.	TYP.	MAX.	FX3964 FX3965 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
FE	DC Current Gain	60	175		180	300			$I_C = 1.0\ \mu A$	$V_{CE} = -5.0\ V$
FE	**DC Current Gain**	**100**	**210**	**300**	**250**	**320**	**500**		$I_C = 10\ \mu A$	$V_{CE} = -5.0\ V$
FE	**DC Current Gain**	**100**	**240**		**250**	**330**			$I_C = 100\ \mu A$	$V_{CE} = -5.0\ V$
FE	**DC Current Gain**	**100**	**260**	**450**	**250**	**330**	**600**		$I_C = 1.0\ mA$	$V_{CE} = -5.0\ V$
FE	DC Pulse Current Gain (Note 5)	100	280		200	330			$I_C = 10\ mA$	$V_{CE} = -5.0\ V$
FE	DC Pulse Current Gain (Note 5)	90	260		180	315			$I_C = 50\ mA$	$V_{CE} = -5.0\ V$
FE(−55°C)	DC Current Gain	40	90		100	160			$I_C = 10\ \mu A$	$V_{CE} = -5.0\ V$
FE(−55°C)	DC Pulse Current Gain	45	150		90	190			$I_C = 50\ mA$	$V_{CE} = -5.0\ V$
FE(100°C)	DC Current Gain		375	600		400	800		$I_C = 1.0\ mA$	$V_{CE} = -5.0\ V$
F	**Wideband Noise Figure** (f = 10 Hz to 10 kHz)		**1.0**	**3.0**		**0.7**	**2.0**	**dB**	$I_C = 20\ \mu A$, $V_{CE} = -5.0\ V$, $R_S = 10\ k\Omega$	
F	**Narrowband Noise Figure** (f = 10 kHz)		**0.8**	**3.0**		**0.5**	**2.0**	**dB**	$I_C = 20\ \mu A$, $V_{CE} = -5.0\ V$ $R_S = 10\ k\Omega$, B.W. = 1.5 kHz	
F	**Narrowband Noise Figure** (f = 1.0 kHz)		**0.8**	**3.0**		**0.5**	**2.0**	**dB**	$I_C = 20\ \mu A$, $V_{CE} = -5.0\ V$ $R_S = 10\ k\Omega$, B.W. = 150 Hz	
F	**Narrowband Noise Figure** (f = 100 Hz)		**3.0**	**10**		**1.8**	**4.0**	**dB**	$I_C = 20\ \mu A$, $V_{CE} = -5.0\ V$ $R_S = 10\ k\Omega$, B.W. = 15 Hz	

tional Electrical Characteristics on Page 2
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*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS FX3962 • FX3963 • FX3964 • FX3965

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FX3962 FX3965 MIN.	TYP.	MAX.	FX3963 FX3964 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CES}	Collector Reverse Current				(FX3963)	0.5	10	nA	$V_{CE} = -70$ V	$V_{EB} = 0$
I_{CES}	Collector Reverse Current		0.5	10				nA	$V_{CE} = -50$ V	$V_{EB} = 0$
I_{CES}	Collector Reverse Current				(FX3964)	0.5	10	nA	$V_{CE} = -40$ V	$V_{EB} = 0$
I_{CES}(125°C)	Collector Reverse Current				(FX3963)	2.0	10	μA	$V_{CE} = -70$ V	$V_{EB} = 0$
I_{CES}(125°C)	Collector Reverse Current		2.0	10				μA	$V_{CE} = -50$ V	$V_{EB} = 0$
I_{CES}(125°C)	Collector Reverse Current				(FX3964)	2.0	10	μA	$V_{CE} = -40$ V	$V_{EB} = 0$
I_{EBO}	Emitter Cutoff Current			10			10	nA	$I_C = 0$	$V_{EB} = -4.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage		−0.1	−0.25		−0.1	−0.25	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		−0.16	−0.4		−0.16	−0.4	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		−0.72	−0.9		−0.72	−0.9	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		−0.81	−0.95		−0.81	−0.95	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
BV_{CBO}	Collector-to-Base Breakdown Voltage	−60			−80 (FX3963)			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CBO}	Collector-to-Base Breakdown Voltage				−45 (FX3964)			Volts	$I_C = 10$ μA	$I_E = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**−60**			**−80** (FX3963)			**Volts**	$I_C = 5.0$ mA (pulsed)	$I_B = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)				**−45** (FX3964)			**Volts**	$I_C = 5.0$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−6.0			−6.0			Volts	$I_C = 0$	$I_E = 10$ μA
C_{cb}	Collector-Base Capacitance			6.0			6.0	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{eb}	Emitter-Base Capacitance			15			15	pF	$I_C = 0$	$V_{EB} = -0.5$ V

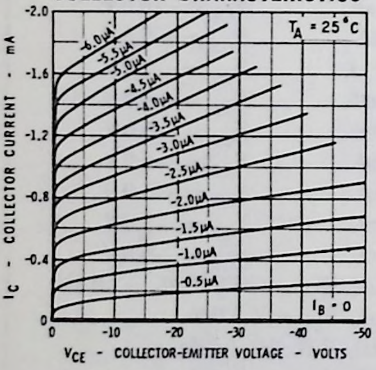
NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 555°C/Watt (derating factor of 1.8 mW/°C) when mounted to a printed circuit with a maximum lead length of 0.03 inch.
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

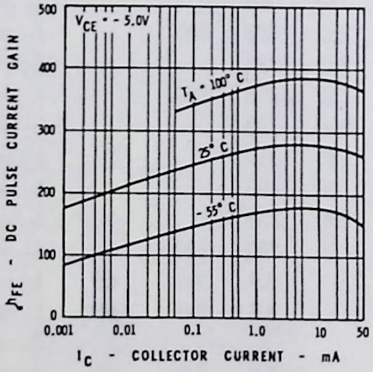
TYPICAL ELECTRICAL CHARACTERISTICS

FX3962 • FX3962

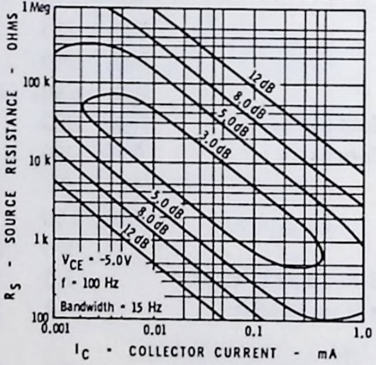
COLLECTOR CHARACTERISTICS*



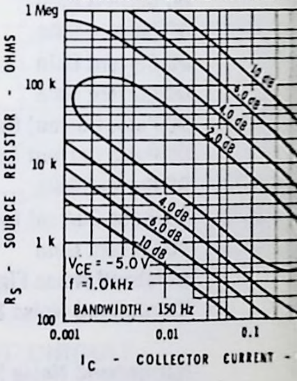
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

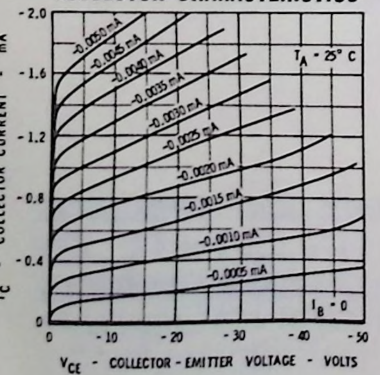


CONTOURS OF CONST
NARROW BAND NOISE F

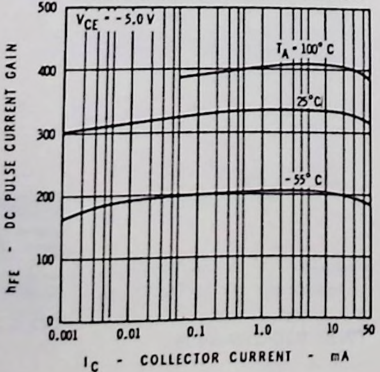


FX3964 • FX3964

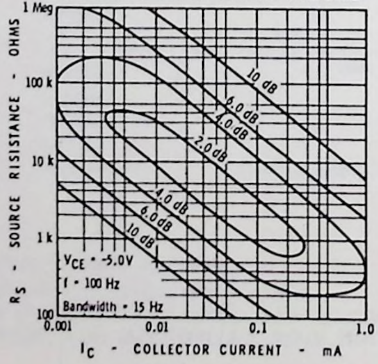
COLLECTOR CHARACTERISTICS*



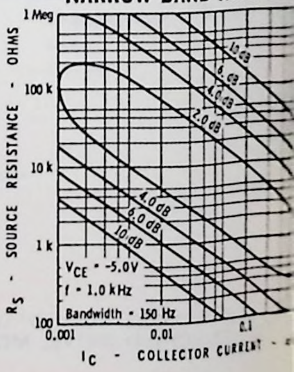
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONST
NARROW BAND NOISE F



* Single family characteristics on Transistor Curve Tracer.

FX4034

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR ADDITIONAL INFORMATION SEE 2N4034

SIMILAR TO 2N4034

HIGH BETA (h_{FE})	**70-200 AT 10 mA**
HIGH FREQUENCY (f_T)	**400 MHz (MIN) AT 10 mA**
EXCELLENT R.F. PERFORMANCE ($r_b{}'C_c$)	**40 ps (MAX)**
LOW CAPACITANCE (C_{cb})	**3.5 pF (MAX)**
LOW NOISE (100 MHz N.F.)	**6.0 dB (MAX)**

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.240 Watt

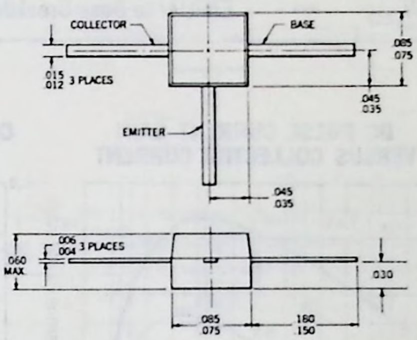
Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	−40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts
I_C	Collector Current	100 mA

PHYSICAL DIMENSIONS

MICRO-PACKAGE

In accordance with JEDEC TO-120



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transfer molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	50			$I_C = 10\ \mu A$	$V_{CE} = -1.0\ V$
h_{FE}	DC Current Gain	50	90			$I_C = 100\ \mu A$	$V_{CE} = -1.0\ V$
h_{FE}	**DC Pulse Current Gain** (Note 5)	**70**	**150**	**200**		$I_C = 10$ mA	$V_{CE} = -1.0\ V$
h_{FE}	DC Pulse Current Gain (Note 5)	15	30			$I_C = 50$ mA	$V_{CE} = -1.0\ V$
$V_{CE(sat)}$	Collector Saturation Voltage (pulsed, Note 5)		−0.2	−0.3	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (pulsed, Note 5)		−0.1	−0.14	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage	−0.7	−0.77	−0.9	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CEO(sus)}$	Collector Emitter Sustaining Voltage (Notes 4 and 5)	−40			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**4.0**	**5.5**			$I_C = 10$ mA	$V_{CE} = -20\ V$
C_{cb}	**Collector-Base Capacitance**		**2.2**	**3.5**	**pF**	$I_E = 0$	$V_{CB} = -10\ V$
C_{eb}	Emitter-Base Capacitance		4.0-	5.5	pF	$I_C = 0$	$V_{EB} = -0.5\ V$
NF	**Noise Figure (f = 100 MHz)**		**3.5**	**6.0**	**dB**	$I_C = 1.0$ mA $R_S = 100\ \Omega$	$V_{CE} = -5.0\ V$ BW = 15 MHz
$r_b{}'C_c$	**Collector Base Time Constant (f = 80 MHz)**			**40**	**ps**	$I_C = 10$ mA	$V_{CE} = -20\ V$
t_{on}	Turn On Time (Note 6)		20	40	ns	$I_C \approx 50$ mA,	$I_{B1} \approx 5.0$ mA
t_{off}	Turn Off Time (Note 6)		95	150	ns	$I_C \approx 50$ mA,	$I_{B1} \approx I_{B2} \approx 5.0$ mA

dditional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process.

OTES:

) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 625°C/Watt (derating factor of 1.6 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.

) This rating refers to a high current point where collector to emitter voltage is lowest.

) Pulse Conditions: length = 300 μs; duty cycle = 1%.

) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

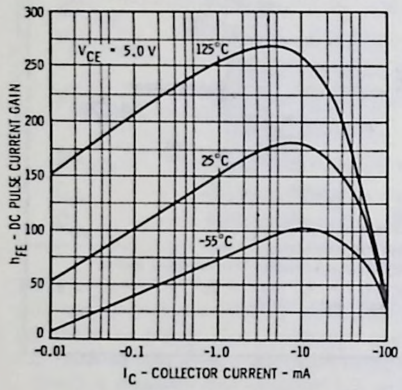
FAIRCHILD TRANSISTOR FX4034

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

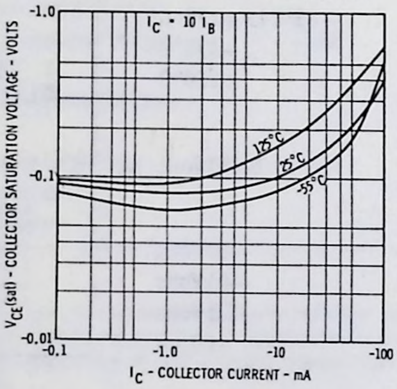
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	60	100			$I_C = 1.0$ mA	$V_{CE} = -1.0$ V
$h_{FE}(-55°C)$	Pulse Current Gain (Note 5)	30	60			$I_C = 10$ mA	$V_{CE} = -1.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage		−0.07	−0.13	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{BE(sat)}$	Base Saturation Voltage (pulsed, Note 5)		−0.88	−1.1	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		−0.65	−0.75	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
I_{CES}	Collector Reverse Current			15	nA	$V_{CE} = -30$ V	$V_{BE} = 0$
$I_{CES}(+125°C)$	Collector Reverse Current			15	μA	$V_{CE} = -30$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−40			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−40			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	$I_C = 0$	$I_E = 10$ μA

TYPICAL ELECTRICAL CHARACTERISTICS

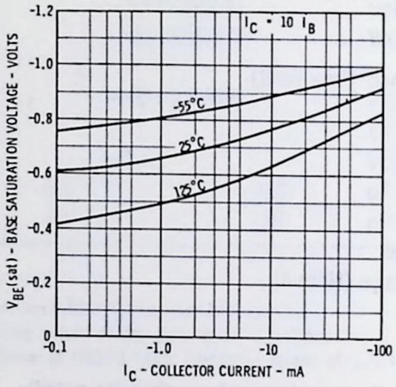
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



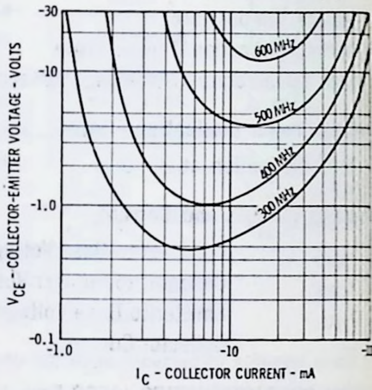
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



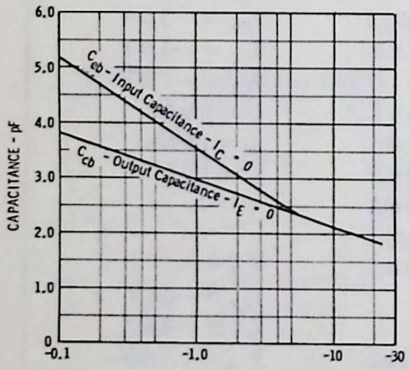
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



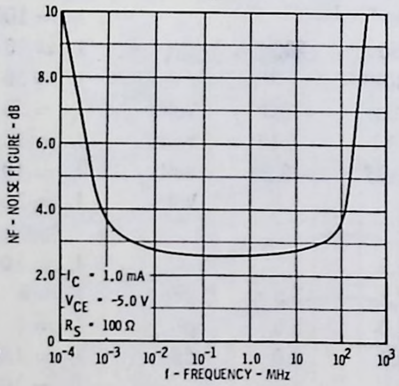
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



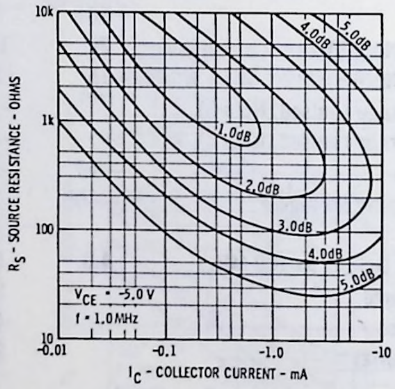
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



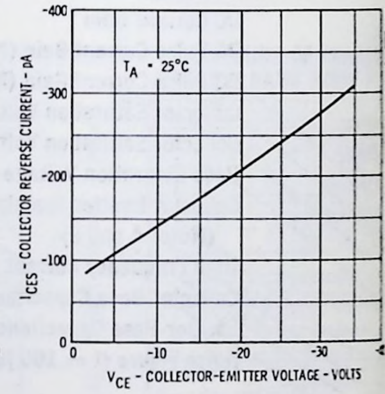
NOISE FIGURE VERSUS FREQUENCY



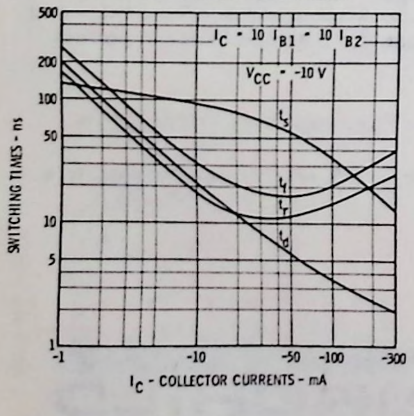
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



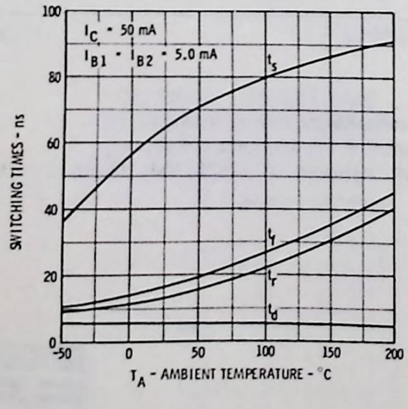
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



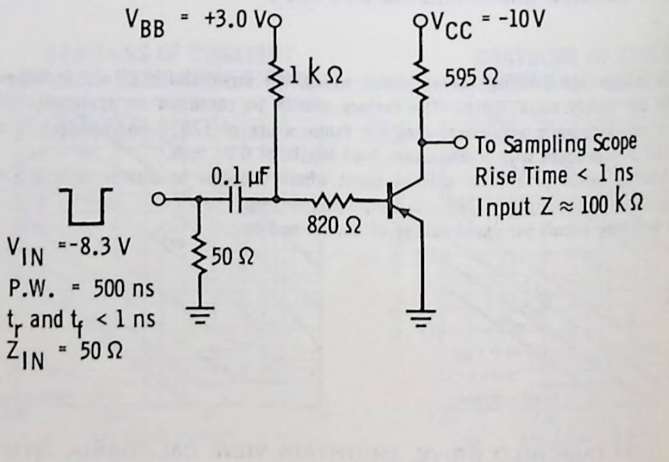
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



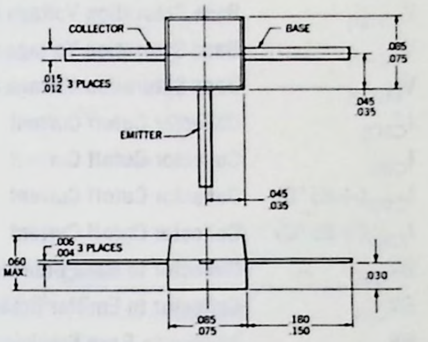
FX4046 • FX4047

NPN HIGH-VOLTAGE, HIGH-CURRENT SWITCHES

μPAK™ SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR ADDITIONAL INFORMATION SEE 2N4046 AND 2N4047

- **SIMILAR TO 2N4046 AND 2N4047**
- **HIGH SPEED . . . . t_{on} = 35 ns (MAX) AT 500 mA**
  t_{off} = 60 ns (MAX) AT 500 mA
- **HIGH VOLTAGE . . . . LV_{CEO} = 50 V (MIN) (FX4047)**
- **LOW SATURATION VOLTAGE . . . $V_{CE(sat)}$ = 1.0 V (MAX) AT 1.0 A (FX4047)**
  $V_{CE(sat)}$ = 0.6 V (MAX) AT 500 mA (FX4047)



NOTES:
1. All dimensions in inches
2. Leads are gold-plated nickel
3. Body is transter molded thermosetting plastic
4. All leads are electrically isolated from the case
5. Package weight is 0.02 gram

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C	0.306 Watt

Maximum Voltages and Current		**FX4046**	**FX4047**
V_{CBO}	Collector to Base Voltage	50 Volts	80 Volts
V_{CES}	Collector to Emitter Voltage	50 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	Maximum Collector Current	500 mA	500 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FX4046			FX4047					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	30			50			Volts	I_C = 10 mA (pulsed)	I_B = 0
$V_{CE(sat)}$	**Collector Saturation Voltage** (Note 5)		0.5	0.90		0.6	1.0	Volts	I_C = 1000 mA (pulsed)	I_B = 100 mA
$V_{CE(sat)}$	**Collector Saturation Voltage** (Note 5)		0.3	0.55		0.4	0.6	Volts	I_C = 500 mA (pulsed)	I_B = 50 mA
t_{on}	**Turn-On Time** (Note 6)		18	35		18	35	ns	$I_C \approx$ 500 mA,	$I_{B1} \approx$ 50 mA
t_{off}	**Turn-Off Time** (Note 6)		45	60		45	60	ns	$I_C \approx$ 500 mA,	$I_{B1} \approx$ 50 mA $I_{B2} \approx$ −50 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.4	4.5		2.4	4.5			I_C = 30 mA	V_{CE} = 5.0 V
C_{cb}	Collector-Base Capacitance		6.0	12		4.8	10	pF	I_E = 0	V_{CB} = 10 V
C_{eb}	Emitter-Base Capacitance		40	55		40	55	pF	I_C = 0	V_{EB} = 0.5 V

ditional Electrical Characteristics on Page 2
tes on Page 2

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

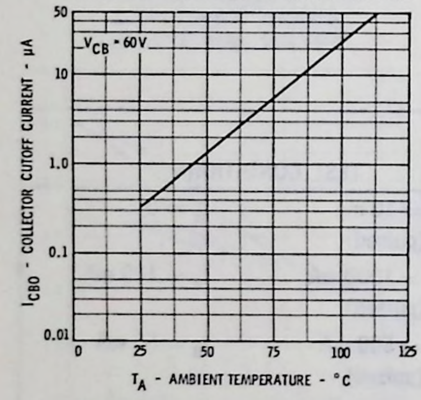
FAIRCHILD TRANSISTORS FX4046 • FX4047

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

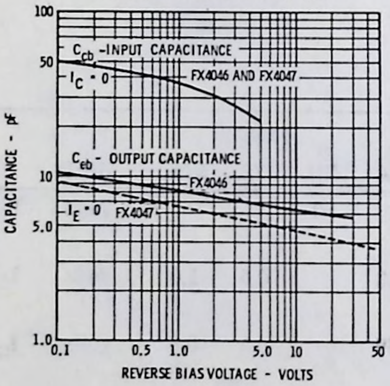
		FX4046			FX4047					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	90	150	40	90	150		$I_C = 100$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	50		20	45			$I_C = 500$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	25	65		15	65			$I_C = 1000$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	60		20	60			$I_C = 10$ mA	$V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.11	0.30		0.19	0.30	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.13	0.2		0.21	0.26	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.64	0.80		0.64	0.80	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.75	0.86		0.75	0.86	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.95	1.3		0.95	1.3	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		1.1	1.8		1.1	1.8	Volts	$I_C = 1000$ mA	$I_B = 100$ mA
I_{CBO}	Collector Cutoff Current		0.25	1.7				μA	$I_E = 0$	$V_{CB} = 40$ V
I_{CBO}	Collector Cutoff Current					0.33	1.7	μA	$I_E = 0$	$V_{CB} = 60$ V
$I_{CBO}(+85°C)$	Collector Cutoff Current		25	120				μA	$I_E = 0$	$V_{CB} = 40$ V
$I_{CBO}(+85°C)$	Collector Cutoff Current					25	120	μA	$I_E = 0$	$V_{CB} = 60$ V
BV_{CBO}	Collector to Base Breakdown Voltage	50			80			Volts	$I_C = 10\ \mu$A	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	50			80			Volts	$I_C = 10\ \mu$A	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 10\ \mu$A

TYPICAL ELECTRICAL CHARACTERISTICS

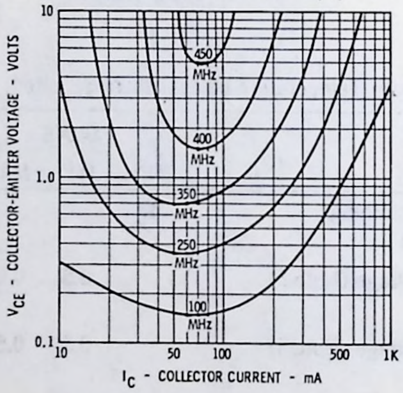
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



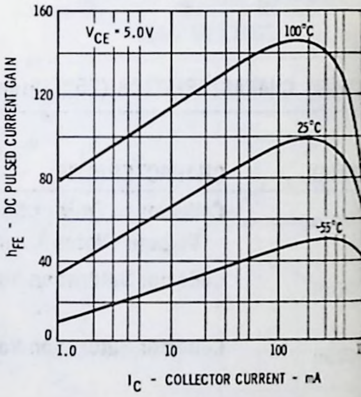
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



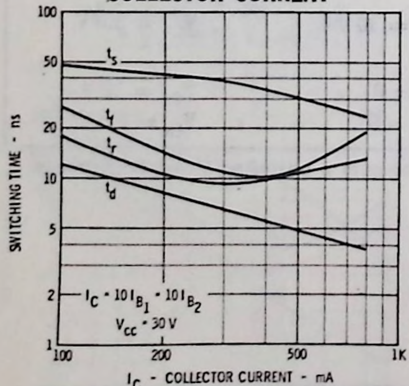
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



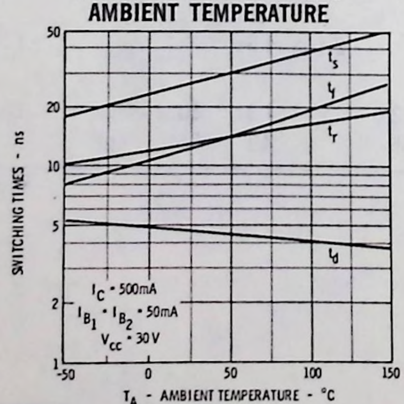
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



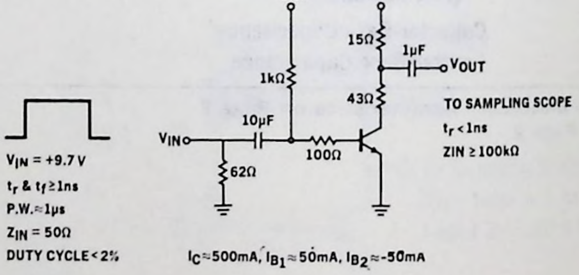
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 490°C/Watt (derating factor of 2.04 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.
(4) Ratings refer to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 µs; duty cycle = 1%.
(6) See switching circuit for exact value of I_C, I_{B1}, and I_{B2}.

FX4207

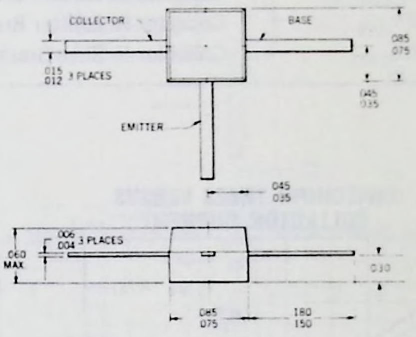
PNP ULTRA HIGH-SPEED SWITCH

μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR ADDITIONAL INFORMATION SEE 2N4207

IMILAR TO 2N4207
LTRA-FAST SWITCHING TIME . . . t_{off} = 30 ns (MAX) AT 10 mA
OW CAPACITY . . . . C_{cb} = 3.0 pF (MAX); C_{eb} = 3.5 pF (MAX)
IGH FREQUENCY . . . . f_T = 650 MHz (MIN) AT 10 mA
OW SATURATION VOLTAGE . . . . $V_{CE(sat)}$ = 0.15 V (MAX) AT 10 mA

PHYSICAL DIMENSIONS
MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES
1 All dimensions in inches
2 Leads are gold-plated nickel
3 Body is transter molded thermosetting plastic
4 All leads are electrically isolated from the case
5 Package weight is 0.02 gram

OLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures		
Storage Temperature		−65°C to +175°C
Operating Junction Temperature		+175°C
Lead Temperature (Soldering, 10 second time limit)		+260°C
aximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C		0.240 Watt
aximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	−6.0 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−6.0 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts
I_C	Collector Current	50 mA

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
s	Charge Storage Time (Note 6)		12	30	ns	I_C = 10 mA I_{B1} =	I_{B2} = 10 mA
on	**Turn On Time** (Note 6)		11	15	ns	I_C = 10 mA	I_{B1} = 1.0 mA
off	**Turn Off Time** (Note 6)		11	30	ns	I_C = 10 mA I_{B1} =	I_{B2} = 1.0 mA
cb	**Collector-Base Capacitance**		2.0	3.0	pF	I_E = 0	V_{CB} = −5.0 V
eb	**Emitter-Base Capacitance**		2.4	3.5	pF	I_C = 0	V_{EB} = −0.5 V
fe	**High Frequency Current Gain (f = 100 MHz)**	6.5	11			I_C = 10 mA	V_{CE} = −5.0 V
FE	DC Current Gain	15	85			I_C = 1.0 mA	V_{CE} = −0.5 V
FE	**DC Pulse Current Gain** (Note 5)	30	100	120		I_C = 10 mA	V_{CE} = −0.3 V
FE	DC Pulse Current Gain (Note 5)	20	75			I_C = 50 mA	V_{CE} = −1.0 V
FE(−55°C)	**DC Pulse Current Gain** (Note 5)	12	50			I_C = 10 mA	V_{CE} = −0.3 V

tional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process.

S:
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FAIRCHILD
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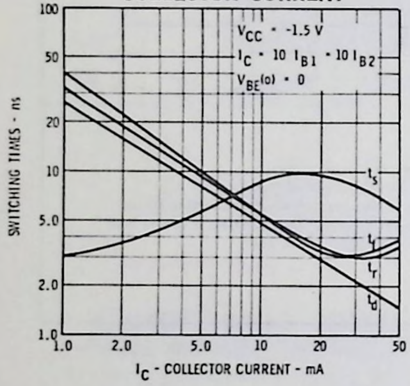
FAIRCHILD TRANSISTOR • FX4207

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

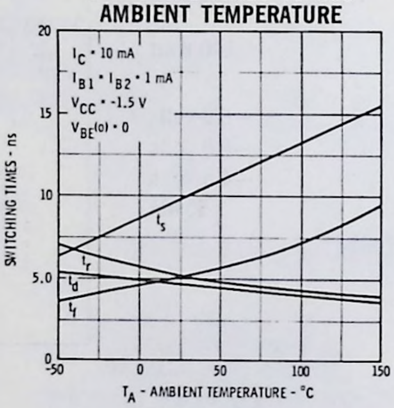
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CE(sat)}$	Collector Saturation Voltage		−0.07	−0.13	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)		**−0.08**	**−0.15**	**Volts**	$I_C = 10$ **mA**	$I_B = 1.0$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.2	−0.5	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		−0.73	−0.8	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage	−0.8	−0.88	−0.95	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage		−1.15	−1.5	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CES}	Collector Reverse Current		0.020	10	nA	$V_{CE} = -3.0$ V	$V_{BE} = 0$
I_{CES}(125°C)	Collector Reverse Current		0.012	5.0	μA	$V_{CE} = -3.0$ V	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5			Volts	$I_C = 0$	$I_E = 100\ \mu$A
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Note 4)	**−6.0**			**Volts**	$I_C = 3.0$ **mA**	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−6.0			Volts	$I_C = 100\ \mu$A	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−6.0			Volts	$I_C = 100\ \mu$A	$I_E = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

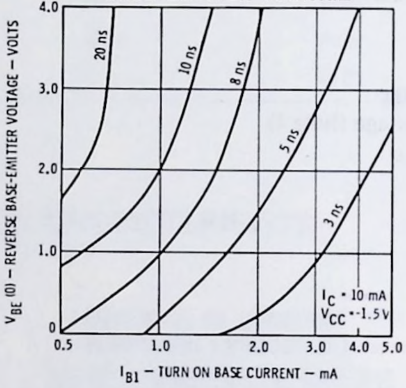
SWITCHING TIMES VERSUS COLLECTOR CURRENT



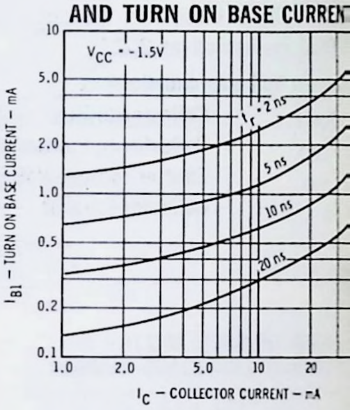
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



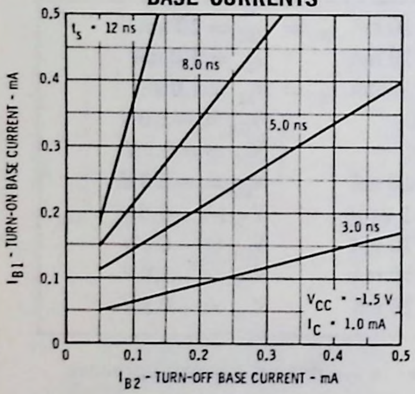
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



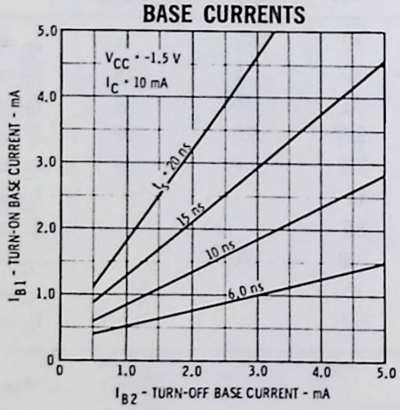
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



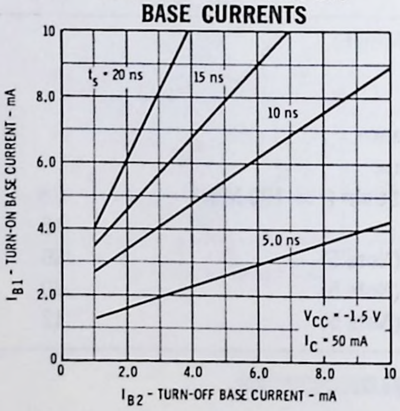
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



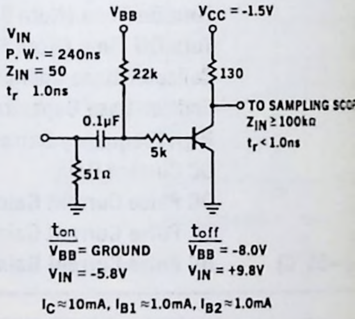
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS

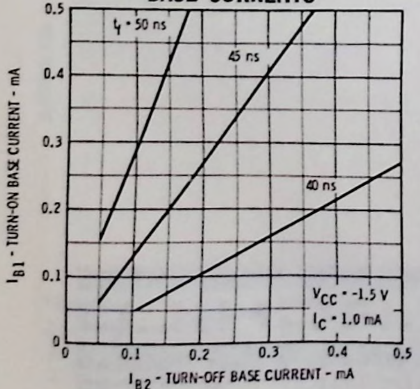


TURN-ON AND TURN-OFF TEST CIRCUIT

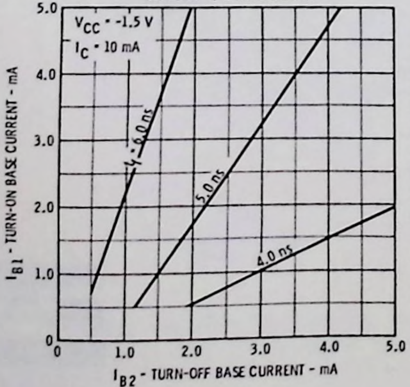


VBB
VCC = -1.5V
VIN
P. W. = 240ns
ZIN = 50
tr 1.0ns
22k
130
TO SAMPLING SCOPE
ZIN ≥ 100kΩ
tr < 1.0ns
0.1μF
5k
51Ω
ton
VBB = GROUND
VIN = -5.8V
toff
VBB = -8.0V
VIN = +9.8V
IC ≈ 10mA, IB1 ≈ 1.0mA, IB2 ≈ 1.0mA

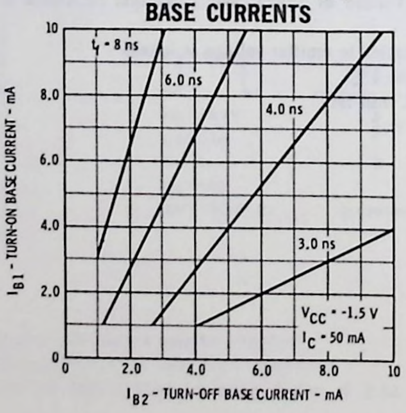
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



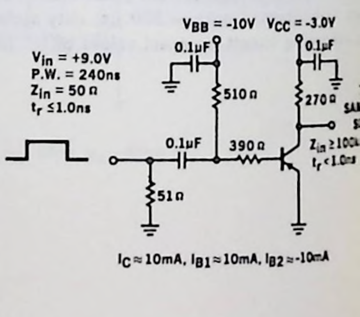
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



CHARGE STORAGE TIME TEST CIRCUIT



VBB = -10V
VCC = -3.0V
0.1μF
Vin = +9.0V
P.W. = 240ns
Zin = 50 Ω
tr ≤ 1.0ns
510 Ω
270 Ω
0.1μF
390 Ω
51 Ω
Zin ≥ 100k
tr < 1.0ns
IC ≈ 10mA, IB1 ≈ 10mA, IB2 ≈ -10mA

FX4960

NPN GENERAL PURPOSE AMPLIFIER AND SWITCH

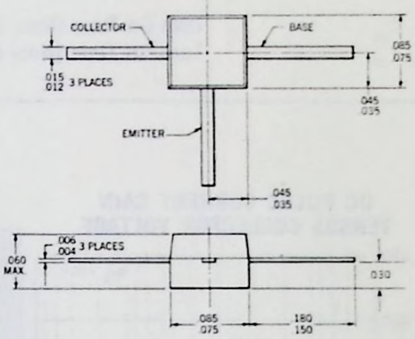
μPAK™ DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR ADDITIONAL INFORMATION SEE 2N4960

SIMILAR TO 2N4960

LV_{CEO} . . . . 60 VOLTS (MIN)
h_{FE} . . . . . 12 SPECIFICATIONS FROM 100 μA TO 500 mA; —55°C TO +125°C
$V_{CE(sat)}$ . . . 0.5 V (MAX) AT 500 mA; 0.18 V (MAX) AT 150 mA
f_T . . . . . . 200 MHz (MIN) AT 30 mA

PHYSICAL DIMENSIONS
MICRO-PACKAGE
In accordance with JEDEC TO-120



NOTES
1 All dimensions in inches
2 Leads are gold plated nickel
3 Body is transfer molded thermosetting plastic
4 All leads are electrically isolated from the case
5 Package weight is 0.02 gram

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−65°C to +175°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 10 second time limit)	+260°C
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C	0.306 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	60 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO} Emitter to Base Voltage	6.5 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	30	60			$I_C = 100$ μA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	60	100			$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	90	140			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	100	150			$I_C = 50$ mA	$V_{CE} = 10$ V
h_{FE}(−55°C)	**DC Pulse Current Gain** (Note 5)	**10**	**40**			**$I_C = 150$ mA**	**$V_{CE} = 1.0$ V**
h_{FE}	**DC Pulse Current Gain** (Note 5)	**40**	**100**			**$I_C = 150$ mA**	**$V_{CE} = 1.0$ V**
h_{FE}(125°C)	DC Pulse Current Gain (Note 5)		130	500		$I_C = 150$ mA	$V_{CE} = 1.0$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	25	60			$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**100**	**180**	**300**		**$I_C = 150$ mA**	**$V_{CE} = 10$ V**
h_{FE}(125°C)	**DC Pulse Current Gain** (Note 5)		**270**	**650**		**$I_C = 150$ mA**	**$V_{CE} = 10$ V**
h_{FE}	DC Pulse Current Gain (Note 5)	70	100			$I_C = 300$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	45	60			$I_C = 500$ mA	$V_{CE} = 10$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**2.0**	**4.0**	**6.0**		**$I_C = 30$ mA**	**$V_{CE} = 5.0$ V**
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.04	0.07	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)		**0.15**	**0.18**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
$V_{CE(sat)}$(125°C)	Pulsed Collector Saturation Voltage (Note 5)		0.18	0.36	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.38	0.58	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.67	0.72	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$(−55°C)	**Pulsed Base Saturation Voltage** (Note 5)		**0.92**	**1.10**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)	**0.78**	**0.82**	**0.90**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
$V_{BE(sat)}$(125°C)	**Pulsed Base Saturation Voltage** (Note 5)	**0.63**	**0.73**		**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)		**1.1**	**1.4**	**Volts**	**$I_C = 500$ mA**	**$I_B = 50$ mA**
$V_{BE(on)}$	Pulsed Base Emitter On Voltage (Note 5)		0.75	0.88	Volts	$I_C = 150$ mA	$V_{CE} = 10$ V
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 & 5)	**60**			**Volts**	**$I_C = 10$ mA**	**$I_B = 0$**
BV_{CES}	Collector to Emitter Breakdown Voltage	60			Volts	$I_C = 10$ μA	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.5			Volts	$I_C = 0$	$I_E = 10$ μA

ditional Electrical Characteristics on Page 2
tes on Page 2

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

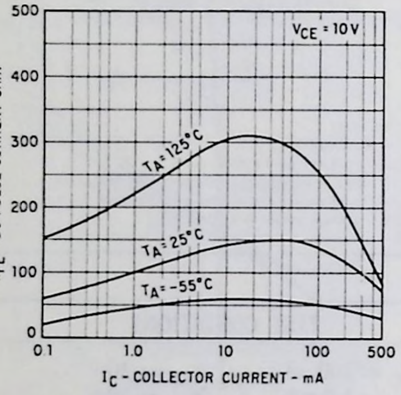
FAIRCHILD TRANSISTOR FX4960

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

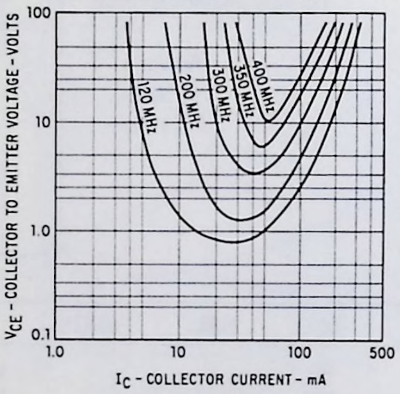
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	Collector Cutoff Current		1.0	10	nA	$I_E = 0$	$V_{CB} = 50\text{ V}$
I_{CBO}(125°C)	Collector Cutoff Current		1.0	10	μA	$I_E = 0$	$V_{CB} = 50\text{ V}$
I_{EBO}	Emitter Cutoff Current		1.0	10	nA	$I_C = 0$	$V_{EB} = 4.0\text{ V}$
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		11	15	pF	$I_E = 0$	$V_{CB} = 10\text{ V}$
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		50	75	pF	$I_C = 0$	$V_{EB} = 0.5\text{ V}$
t_{on}	Turn On Time (Note 6, Fig. 1)		70	150	ns	$I_C \approx 150\text{ mA}$	$I_{B1} \approx 15\text{ mA}$
t_{off}	Turn Off Time (Note 6, Fig. 1)		700	1000	ns	$I_C \approx 150\text{ mA}$	$I_{B1} \approx 15\text{ mA}$ $I_{B2} \approx -15\text{ mA}$
t_{on}	Turn On Time (Note 6, Fig. 1)		80		ns	$I_C \approx 300\text{ mA}$	$I_{B1} \approx 30\text{ mA}$
t_{off}	Turn Off Time (Note 6, Fig. 1)		600		ns	$I_C \approx 300\text{ mA}$	$I_{B1} \approx 30\text{ mA}$ $I_{B2} \approx -30\text{ mA}$
t_{on}	Turn On Time (Note 6, Fig. 1)		100		ns	$I_C \approx 500\text{ mA}$	$I_{B1} \approx 50\text{ mA}$
t_{off}	Turn Off Time (Note 6, Fig. 1)		500		ns	$I_C \approx 500\text{ mA}$	$I_{B1} \approx 50\text{ mA}$ $I_{B2} \approx -50\text{ mA}$

TYPICAL ELECTRICAL CHARACTERISTICS

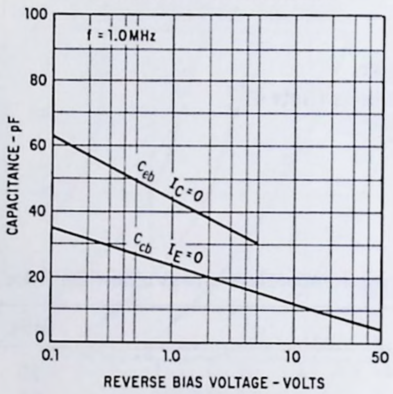
DC PULSE CURRENT GAIN VERSUS COLLECTOR VOLTAGE



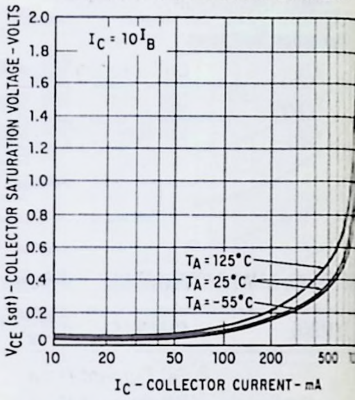
CONTOUR OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



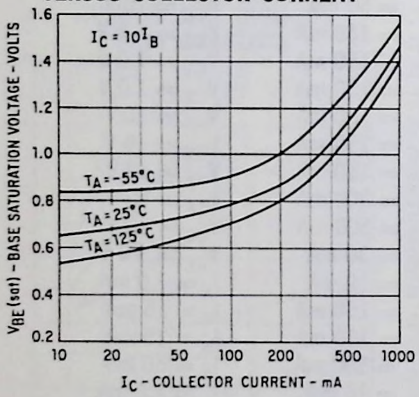
COLLECTOR-BASE AND EMITTER-BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



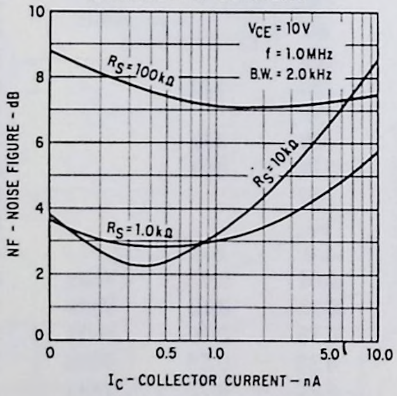
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



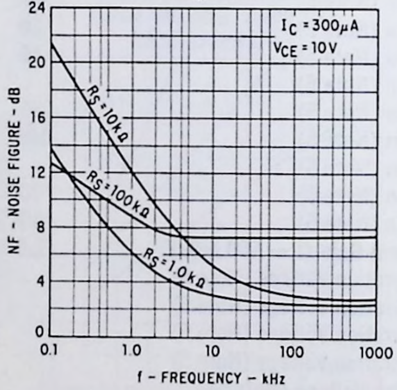
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



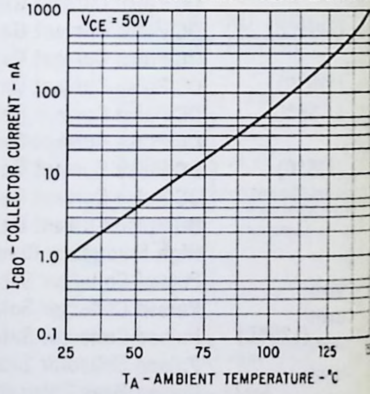
NOISE FIGURE VERSUS COLLECTOR CURRENT



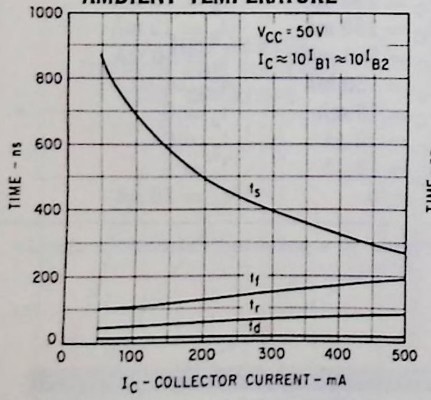
NOISE FIGURE VERSUS FREQUENCY



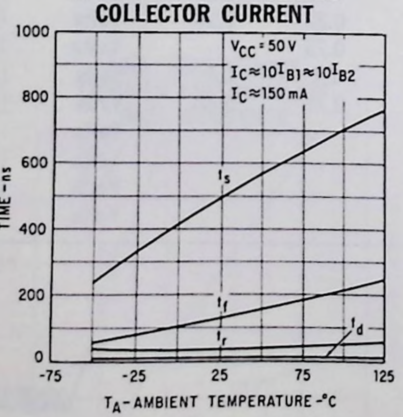
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

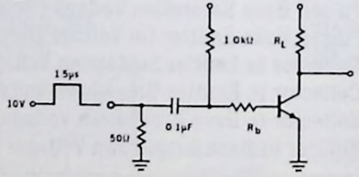


SWITCHING TIMES VERSUS COLLECTOR CURRENT



t_{on} - t_{off} TEST CIRCUIT

Figure 1



To Sampling Scope
Rise Time ≤ 1.0 ns
Input Z ≈ 100 kΩ

Pulse Source
Rise Time ≤ 5.0 ns
Fall Time ≤ 10 ns

Ic	Rb	RL
150 mA	314 Ω	330 Ω
300 mA	157 Ω	167 Ω
500 mA	94 Ω	100 Ω

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and a thermal resistance of 490°C/Watt (derating factor of 2.04 mW/°C) when mounted to a printed circuit board with a maximum lead length of 0.03 inch.
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of Ic, IB1 and IB2.

Switching, General Purpose, and RF Transistors (Epoxy)

High Speed Switches
General Purpose Amplifiers
RF/IF Amplifiers
RF/IF Oscillators

SWITCHING, GENERAL PURPOSE, AND RF TRANSISTOR (EPOXY) NUMERICAL INDEX

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EN2219	4-22	EN3962	4-93	2N5133	4-180
EN2222	4-22	SE4001	4-95	2N5134	4-181
EN2369A	4-8	SE4002	4-95	2N5135	4-183
EN2484	4-14	SE4010	4-95	2N5136	4-184
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SE3005	4-31	2N4249	4-112	2N5142	4-193
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EN3013	4-33	2N4258	4-114	2N5243	4-195
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2N3564	4-41	2N4355	4-126	SE6021A	4-200
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HIGH SPEED SWITCH SELECTION GUIDE

Rated V_{CEO} Volts	Optimum Collector Current mA 0.1 — 50 NPN	PNP	10 — 100 NPN	PNP	100 — 300 NPN	PNP	300 — 500 NPN	PNP	500 — 1000 NPN	PNP
5-6		2N5141		2N5141						
		2N4257		2N4257						
		2N5140		2N5140						
12	2N4274	2N4258	2N4274	2N4258					2N3426	
		2N4389		2N4389						
		2N5055		2N4313						
				2N5055						
15	2N4275		2N3646		2N3646					
			2N4275							
20-25		2N3638		2N3638		2N3638		2N5242*		2N5242
		2N3638A		2N3638A		2N3638A				
		2N5142, 3		2N5142, 3		2N5142, 3				
				2N5242*		2N5242*				
30-45	FT3641*	2N4916	FT3641*	2N5243	FT3641*	2N5243*	FT3641	2N5243*		2N5243
	FT3643*	2N4121	FT3643*	2N4916	FT3643*	FT3644*	FT3643			
	2N4436	FT3644*	2N4436	2N4121	2N4436		2N3724			
	2N4437		2N4437	FT3644*	2N4437		2N4436			
	FT3642*		FT3642*		FT3642*		2N4437			
							FT3642			
46-60		FT3645*	FT3722*	FT3645*	FT3722*	FT3645*	FT3722*		FT3722*	
		2N3645		2N3645		2N3645				

*High dissipation epoxy package devices. FT numbers are the high dissipation versions of the corresponding 2N numbers.

HIGH SPEED SWITCH (EPOXY) NUMERICAL INDEX

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EN3504	4-37				

GENERAL PURPOSE AMPLIFIER SELECTION GUIDE

Rated V_{CEO} Volts	Optimum Collector Current mA									
	0.10 — 50		10 — 100		100 — 300		300 — 500		500 — 1000	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
12–20	2N5128, 29 2N5131, 32 2N5136, 37	2N5139	2N5128, 29 2N5136, 37	2N5142	2N5128, 29 2N5136, 37	2N5142	2N5128, 29 2N5136, 37		2N5136, 37	
20–30	2N3565 2N3566 FT3641*, 43* 2N3691-94 SE4022 2N4436, 37 2N5135	2N3638, 38A 2N4916, 17 2N5138 2N4121	2N3566 FT3641*, 43* 2N4436, 37 2N5135 SE8040*	2N3638, 38A 2N5143 FT5040* SE8540*	2N3566 FT3641*, 43* 2N4436, 37 2N5135 SE8040*	2N3638, 38A FT5040* 2N5143 SE8540*	FT3641*, 43* 2N4436, 37 SE8040*	FT5040* SE8540*	SE8040*	FT5040* SE8540*
40–45	FT3567*, 69* FT3642* SE4021 2N4944, 46	2N4248, 50 FT3644*	FT3567*, 69* FT3642* 2N4944, 46	FT3644* FT5041*	FT3567*, 69* FT3642* 2N4944, 46	FT3644* FT5041*	FT3567*, 69* FT3642* 2N4944, 46	FT5041*	FT3567*, 69* 2N4944, 46	FT5041*
600	FT3568* SE4020 2N4945 SE6020, A* SE6022	2N4249 FT3645* FT4354*, 55*	FT3568* 2N4945 SE6020, A* SE6022	FT3645* FT4354* FT4355*	FT3568* 2N4945 SE6020, A* SE6022	FT3645* FT4354* FT4355*	FT3568* 2N4945 SE6020, A* SE6022	FT4354* FT4355*	FT3568* 2N4945	FT4354* FT4355*
800	SE6021, A* SE6023	FT4356*	SE6021, A* SE6023	FT4356*	SE6021, A* SE6023	FT4356*	SE6021, A* SE6023	FT4356*		FT4356*
1200	SE7015*									
1500	SE7016*	2N4888, 89								
1800	SE7017*									

gh dissipation epoxy package devices. FT numbers are the high dissipation versions of the corresponding 2N numbers.

GENERAL PURPOSE AMPLIFIER & SWITCH (EPOXY) NUMERICAL INDEX

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EN722	4-6	2N3642	4-61	2N4946	4-144
EN870	4-10	FT3642	4-65	2N5040	4-154
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EN1613	4-4	2N3693	4-86	2N5133	4-180
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SE2001	4-21	EN3692	4-93	2N5136	4-184
SE2002	4-21	SE4001	4-95	2N5137	4-184
EN2219	4-22	SE4002	4-95	2N5138	4-185
EN2222	4-22	SE4010	4-95	2N5139	4-187
EN2484	4-14	2N4121	4-108	2N5142	4-193
EN2905	4-25	2N4248	4-112	2N5143	4-193
EN2907	4-25	2N4249	4-112	SE6001	4-199
EN3250	4-35	2N4250	4-112	SE6002	4-199
EN3502	4-37	2N4257	4-114	SE6020	4-200
EN3504	4-37	2N4258	4-114	SE6020A	4-200
2N3565	4-43	2N4354	4-126	SE6021	4-200
2N3566	4-45	2N4355	4-126	SE6021A	4-200
2N3567	4-47	2N4356	4-126	SE6022	4-200
FT3567	4-49	2N4436	4-134	SE6023	4-200
2N3568	4-47	2N4437	4-134	SE7015	4-204
FT3568	4-49	2N4888	4-138	SE7016	4-204
2N3569	4-51	2N4889	4-138	SE7017	4-204
FT3569	4-49	2N4916	4-142	SE8040	4-208
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RF/IF AMPLIFIER SELECTION GUIDE

f MHz	Polarity	Device	Power Gain dB (min)	@	f MHz	NF dB (max)	@	f MHz	C_{bc} pF (max)
27	NPN	SE8012*	10.8		27				9.0
30	NPN	FT3641*	10		30				8.0
	NPN	2N4436	10		30				8.0
45	NPN	2N3688	29		45				1.6
100	PNP	2N4121	25 typ		100	6		100	4.5
	PNP	2N4916	25 typ		100	6		100	4.5
	NPN	SE5006	20		100	5.5 typ		100	1.6
200	NPN	SE3001	12		200	4 typ		60	1.7
	NPN	2N3690	15		200	5.5		200	1.6
	NPN	2N3563	14		200	4 typ		60	1.7
250	NPN	SE1010	6 typ		250	5.5		1.0	3.5
		2N3564	6 typ		250	3.7 typ		1.0	3.5

*FT3641 is a high dissipation epoxy package version of 2N3641; SE8012 is a high dissipation epoxy device.

RF/IF OSCILLATOR SELECTION GUIDE

f MHz	Polarity	Device	OSC P_O mW (min)	@	I_C mA
100	PNP	2N4916	200 typ		10
	PNP	2N4121	200 typ		10
500	PNP	2N4258	10 typ		10
930	NPN	SE3002	3.0		8.0
1000	NPN	SE3005	15		8.0

RF/IF AMPLIFIER & OSCILLATOR (EPOXY) NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
EN918	4-13	2N3642	4-61	2N4437	4-134
SE1010	4-19	FT3642	4-65	2N4916	4-142
SE3001	4-27	2N3643	4-61	2N4917	4-142
SE3002	4-27	FT3643	4-65	SE5001	4-145
SE3005	4-31	2N3688	4-80	SE5002	4-145
2N3563	4-39	2N3689	4-80	SE5003	4-145
2N3564	4-41	2N3690	4-80	SE5006	4-149
2N3639	4-57	2N4121	4-108	SE5025	4-152
2N3640	4-57	2N4257	4-114	SE5126	4-170
2N3641	4-61	2N4258	4-114	SE5127	4-172
FT3641	4-65	2N4436	4-134	SE5130	4-175

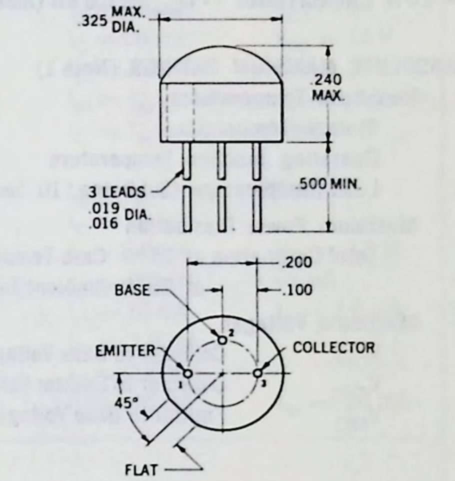
EN697

NPN GENERAL PURPOSE AMPLIFIER

DOUBLE DIFFUSED SILICON PLANAR* TRANSISTOR

- **ELECTRICAL REPLACEMENT FOR 2N697**
- **MEDIUM VOLTAGE - - $LV_{CEO} = 30$ V (MIN)**
- **MEDIUM GAIN - - $h_{FE} = 40\text{-}120$ AT 150 mA**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +125°C
Operating Junction Temperature		125°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Notes 2 & 3)		0.8 Watt
at 25°C Ambient Temperature		0.3 Watt
Maximum Voltages		
V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	**Collector to Emitter Voltage**	**30 Volts**
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	120		$I_C = 150$ mA	$V_{CE} = 10$ V
V_{BE}(sat)	Base Saturation Voltage		1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE}(sat)	Collector Saturation Voltage		1.5	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.5			$I_C = 30$ mA	$V_{CE} = 10$ V
C_{obo}	Output Capacitance		35	pF	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}	Collector Cutoff Current		1.0	μA	$I_E = 0$	$V_{CB} = 30$ V
I_{CBO}(100°C)	Collector Cutoff Current		10	μA	$I_E = 0$	$V_{CB} = 30$ V
h_{ib}	Input Resistance (f = 1.0 kHz)	24	34	Ω	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
		4.0	8.0	Ω	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio (f = 1.0 kHz)		5.0	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
			5.0	$\times 10^{-4}$	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	25	175		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
		35	200		$I_C = 5.0$ mA	$V_{CE} = 10$ V
h_{ob}	Output Conductance (f = 1.0 kHz)	0.1	0.5	μmho	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
		0.1	1.0	μmho	$I_C = 5.0$ mA	$V_{CB} = 10$ V

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300μs; duty cycle = 1%.

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EN706 • EN708 • EN914

NPN HIGH SPEED SATURATED SWITCHES

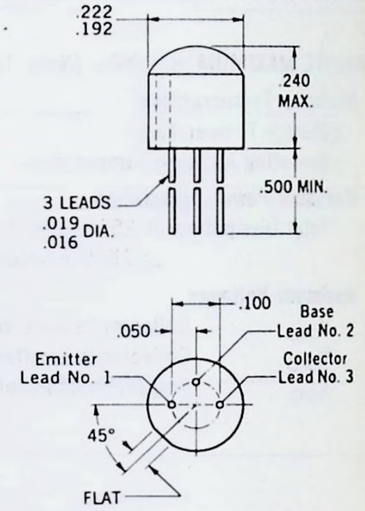
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION, SEE FAIRCHILD 2N706, 2N708, AND 2N914 DATA SHEETS

- **ELECTRICAL REPLACEMENTS FOR 2N706, 2N708 AND 2N 914**
- **HIGH SPEED - - T_S = 20 ns (max) at 20 mA**
- **HIGH FREQUENCY - - f_T = 300 MHz (min) at 20 mA**
- **LOW CAPACITANCE - - C_{obo} = 6.0 dB (max) at 5.0 V**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +125°C
Operating Junction Temperature	125°C
Lead Temperature (Soldering, 10 Second Time Limit)	260°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages

		EN 706	**EN 708**	**EN 914**
V_{CBO}	Collector to Base Voltage	25 V	40 V	40 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 V	15 V	15 V
V_{EBO}	Emitter to Base Voltage	3.0 V	5.0 V	5.0 V

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	EN706 MIN.	EN706 MAX.	EN708 MIN.	EN708 MAX.	EN914 MIN.	EN914 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	20		30	120	30	120		I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)			15		12			I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)			15					I_C = 0.5 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)					10			I_C = 500 mA	V_{CE} = 5.0 V
V_{CE}(sat)	Collector Saturation Voltage		0.6		0.4			Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat) (−55°C to +125°C)	Collector Saturation Voltage				0.4			Volts	I_C = 7.0 mA	I_B = 0.7 mA
V_{CE}(sat) (−55°C to +125°C)	Collector Saturation Voltage (Note 6)						0.25	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage						0.70	Volts	I_C = 200 mA	I_B = 200 mA
V_{BE}(sat)	Base Saturation Voltage		0.9	0.72	0.85	0.70	0.80	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat) (−55°C)	Base Saturation Voltage				0.95			Volts	I_C = 7 mA	I_B = 0.7 mA
I_{CBO}	Collector Cutoff Current		0.5					nA	V_{CB} = 15 V	I_E = 0
I_{CBO}	Collector Cutoff Current				50		100	nA	V_{CB} = 20 V	I_E = 0
I_{CEX}(+100°C)	Collector Cutoff Current				25		25	μA	V_{CE} = 20 V	V_{BE} = 0.25 V
I_{CBO}(+100°C)	Collector Cutoff Current		30		25		25	μA	V_{CB} = 20 V	I_E = 0
r'_b	Base Spreading Resistance (Note 7)				75			Ω	I_C = 10 mA	V_{CE} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	25		40		40		Volts	I_C = 1.0 mA	I_E = 0

*Planar is a patented Fairchild process.

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FAIRCHILD TRANSISTORS EN706 • EN708 • EN914

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	EN706 MIN.	EN706 MAX.	EN708 MIN.	EN708 MAX.	EN914 MIN.	EN914 MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	15		15		15		Volts	$I_C = 30$ mA	(pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		5.0		5.0		Volts	$I_C = 0$	$I_E = 100\ \mu A$
C_{ob}	**Output Capacitance**		**6.0**		**6.0**		**6.0**	**pF**	$I_E = 0$	$V_{CB} = 10$ V
C_{ib}	Input Capacitance						9.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0							$I_C = 10$ mA	$V_{CE} = 15$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)			3.0					$I_C = 10$ mA	$V_{CE} = 10$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**					**3.0**			$I_C = 20$ mA	$V_{CE} = 10$ V
τ_s	Charge Storage Time Constant (Note 8)		60					ns	$I_C \approx 10$ mA $I_{B1} \approx I_{B2} \approx 10$ mA	$V_{CC} = 10$ V $R_L = 1\ k\Omega$
τ_s	Charge Storage Time Constant (Note 9)				25			ns	$I_C \approx I_{B1} \approx I_{B2} \approx 10$ mA	
τ_s	**Charge Storage Time Constant** (Note 10)						**20**	**ns**	$I_C \approx I_{B1} \approx I_{B2} \approx 20$ mA	
t_{on}	Turn On Time				40			ns	$I_C \approx 10$ mA $I_B \approx 3.0$ mA	 $V_{BE} = 2.0$ V
t_{on}	Turn On Time						40	ns	$I_C \approx 200$ mA $I_{B1} \approx 40$ mA	
t_{off}	Turn Off Time				75			ns	$I_C \approx 10$ mA $I_{B2} \approx 1.0$ mA	$I_B \approx 3.0$ mA
t_{off}	Turn Off Time						40	ns	$I_C \approx 200$ mA $I_{B1} \approx 40$ mA	 $I_{B2} \approx 20$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.
(5) Pulse conditions: Length = 300 μs; duty cycle = 1%.
(6) $I_C = 1.0$ mA through 20 mA.
(7) $r_b' =$ hie(Real Part) - Measured with GR#1607-A Bridge.
(8) Conditions chosen to make storage time approximately independent of transistor h_{FE}, Measurement with Tektronix R plug-in unit. $\tau_s = K_s \ln 2$.
(9) Measured on sampling scope, PW 400ns.
(10) Measured on sampling scope, PW 200ns.

EN718A · EN956 · EN1613 · EN1711

NPN GENERAL PURPOSE AMPLIFIERS

DOUBLE DIFFUSED SILICON PLANAR* TRANSISTORS

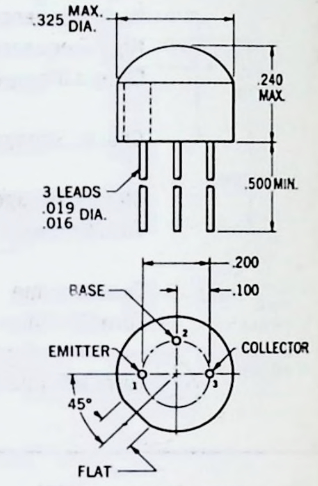
FOR ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N718A DATA SHEET

- **ELECTRICAL REPLACEMENTS FOR 2N718A, 2N956, 2N1613 AND 2N1711**
- **HIGH GAIN - - $h_{FE} = 100\text{-}300$ at 150 mA**
  $h_{FE} = 35$ (min) at 100 μA
  $h_{FE} = 40$ (min) at 500 mA
- **HIGH VOLTAGE - - $LV_{CEO} = 40$ V (min)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

		EN718A EN956	EN1613 EN1711
Maximum Temperatures			
Storage Temperature		−65°C to +125°C	
Operating Junction Temperature		+125°C Maximum	
Maximum Power Dissipation			
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		0.6 Watt	0.8 Watt
at 25°C Ambient Temperature (Notes 2 and 3)		0.22 Watt	0.3 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage		75 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)		40 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



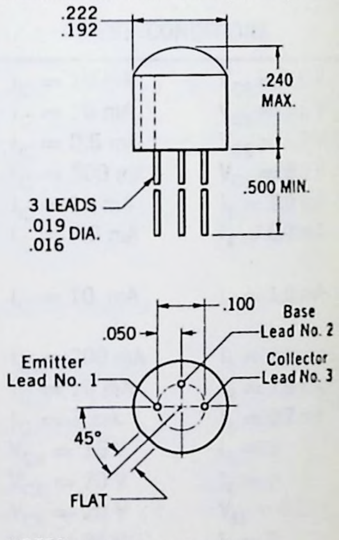
NOTES: All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

EN1613 • EN1711

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	EN718A EN1613 MIN.	EN718A EN1613 MAX.	EN956 EN1711 MIN.	EN956 EN1711 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	40	120	**100**	**300**		**$I_C = 150$ mA**	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	35		75			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	20		**40**			**$I_C = 500$ mA**	$V_{CE} = 10$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	20		30			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	**DC Current Gain**	20		**35**			**$I_C = 0.1$ mA**	$V_{CE} = 10$ V
h_{FE}	DC Current Gain			20			$I_C = 0.01$ mA	$V_{CE} = 10$ V
V_{BE}(sat)	Base Saturation Voltage (Pulsed, Note 5)		1.3		1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, Note 5)		1.5		1.5	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0		3.5			$I_C = 30$ mA	$V_{CE} = 10$ V
C_{obo}	Output Capacitance		25		25	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{ibo}	Emitter Transition Capacitance		80		80	pF	$I_C = 0$	$V_{EB} = 0.5$ V
NF	Noise Figure (Note 6)		12		8.0	dB	$I_C = 0.3$ mA	$V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current		50		50	mμA	$I_E = 0$	$V_{CB} = 60$ V
I_{CBO}(100°C)	Collector Cutoff Current		10		10	μA	$I_E = 0$	$V_{CB} = 60$ V
BV_{CBO}	Collector to Base Breakdown Voltage	75		75		Volts	$I_C = 0.1$ mA	$I_E = 0$

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outli



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive materia

EN718A • EN956

*Planar is a patented Fairchild proce

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FAIRCHILD TRANSISTORS EN718A • EN956 • EN1613 • EN1711

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	EN718A EN1613 MIN.	EN718A EN1613 MAX.	EN956 EN1711 MIN.	EN956 EN1711 MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40		40		Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		Volts	$I_C = 0$	$I_E = 0.1$ mA
I_{EBO}	Emitter Current		50		50	mμA	$I_C = 0$	$V_{EB} = 5.0$ V
h_{ib}	Input Resistance (f = 1.0 kHz)	24	34	24	34	Ω	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
		4.0	8.0	4.0	8.0	Ω	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio (f = 1.0 kHz)		5.0		5.0	$x10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
			5.0		5.0	$x10^{-4}$	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	25	175	50	400		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
		35	200	70	400		$I_C = 5.0$ mA	$V_{CE} = 10$ V
h_{ob}	Output Conductance (f = 1.0 kHz)	0.1	0.5	0.1	0.5	μmho	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
		0.1	1.0	0.1	1.0	μmho	$I_C = 5.0$ mA	$V_{CB} = 10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C) for the EN1613 and EN1711; for the EN718A and EN956 167°C/Watt (derating factor of 6.0 mW/°C). Junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C) for the EN1613 and EN1711; for the EN718A and EN956 455°C/Watt (derating factor of 2.2mW/°C).

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.

(6) f = 1000 Hz; $R_G = 510\Omega$; 1.0 Hz bandwidth.

EN722 · EN1132

PNP GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N722 DATA SHEET

- **ELECTRICAL REPLACEMENTS FOR 2N722 and 2N1132**
- **BREAKDOWN VOLTAGE . . . . BV_{CBO} = 50 V (MIN)**
  . . . . LV_{CEO} = 35 V (MIN)
- **BETA . . . . h_{FE} = 30–90 @ 150 mA**
- **FREQUENCY . . . . f_T = 60 MHz (MIN)**
- **CAPACITANCE . . . . C_{ob} = 45 pF (MAX)**

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	+260°C Maximum

Maximum Power Dissipation

	EN722	EN1132
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt	0.7 Watt
at 25°C Free Air Temperature [Notes 2 and 3]	0.2 Watt	0.3 Watt

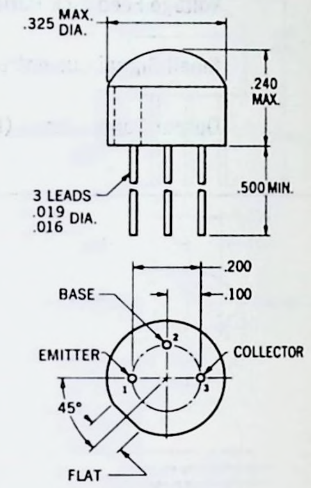
Maximum Voltages

V_{CBO}	Collector to Base Voltage	−50 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−35 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	25			I_C = 5.0 mA	V_{CE} = −10 V
h_{FE}	**DC Pulse Current Gain** [Note 5]	**30**	**90**		**I_C = 150 mA**	**V_{CE} = −10 V**
V_{BE} (sat)	Base Saturation Voltage		−1.3	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage		−1.5	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**3.0**			**I_C = 50 mA**	**V_{CE} = −3.0 V**
C_{ob}	**Output Capacitance**		**45**	**pF**	**I_E = 0**	**V_{CB} = −10 V**
C_{TE}	Emitter Transition Capacitance (for EN722 only)		100	pF	I_C = 0	V_{EB} = −0.5 V
C_{TE}	Emitter Transition Capacitance (for EN1132 only)		80	pF	I_C = 0	V_{EB} = −0.5 V
I_{CBO}	Collector Cutoff Current		1.0	μA	I_E = 0	V_{CB} = −30 V
I_{CBO} (100°C)	Collector Cutoff Current		100	μA	I_E = 0	V_{CB} = −30 V
I_{EBO}	Emitter Cutoff Current		100	μA	I_C = 0	V_{EB} = −5.0 V
BV_{CBO}	**Collector to Base Breakdown Voltage**	**−50**		**Volts**	**I_C = 100 μA**	**I_E = 0**

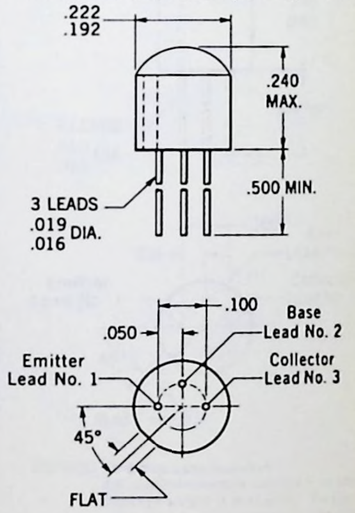
PHYSICAL DIMENSIONS
in accordance with JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

EN1132

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

EN722

*Planar is a patented Fairchild process.

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS EN722 EN1132

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage**	—35		Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Voltage	—5.0		Volts	$I_C = 0$	$I_E = 100\ \mu A$
h_{fe}	Current Transfer Ratio	25	100		$V_{CE} = -5$ V	$I_C = 1.0$ mA f = 1.0 kHz
h_{fe}	Current Transfer Ratio	30			$V_{CE} = -10$ V	$I_C = 5.0$ mA f = 1.0 kHz
h_{ib}	Input Resistance	25	35	Ω	$V_{CB} = -5$ V	$I_C = 1.0$ mA f = 1.0 kHz
h_{ib}	Input Resistance		10	Ω	$V_{CB} = -10$ V	$I_C = 5.0$ mA f = 1.0 kHz
h_{rb}	Voltage Feedback Ratio		8.0	$\times 10^{-4}$	$V_{CB} = -5$ V	$I_C = 1.0$ mA f = 1.0 kHz
h_{rb}	Voltage Feedback Ratio		8.0	$\times 10^{-4}$	$V_{CB} = -10$ V	$I_C = 5.0$ mA f = 1.0 kHz
h_{ob}	Output Conductance		1.0	μmho	$V_{CB} = -5$ V	$I_C = 1.0$ mA f = 1.0 kHz
h_{ob}	Output Conductance		5.0	μmho	$V_{CB} = -10$ V	$I_C = 5.0$ mA, f = 1.0 kHz

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/watt (derating factor of 7.0 mW/°C) for the EN1132 and 200°C/watt (derating factor of 5.0 mW/°C) for the EN722; junction to ambient thermal-resistance of 333°C/watt (derating factor of 3.0 mW/°C) for the EN1132 and 500°C/watt (derating factor of 2.0 mW/°C) for the EN722.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

EN744 • EN2369A • EN3011

NPN HIGH-SPEED SATURATED SWITCHES

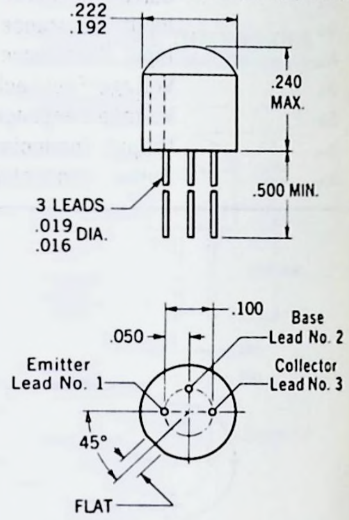
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION, SEE FAIRCHILD 2N744, 2N2369A AND 2N3011 DATA SHEETS

- **ELECTRICAL REPLACEMENTS FOR 2N744, 2N2369A AND 2N3011**
- **HIGH SPEED - - $\tau_s = 13$ ns (max) at 10 mA**
  - - $t_{on} = 12$ ns (max) at 10 mA
  - - $t_{off} = 18$ ns (max) at 10 mA
- **MEDIUM VOLTAGE - - $LV_{CEO} = 15$ V (min)**
- **MEDIUM GAIN - - $h_{FE} = 40$ (min) at 10 mA, 0.35 V**
- **HIGH FREQUENCY - - $f_T = 500$ MHz (min) at 10 mA**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +125°C
Operating Junction Temperature	125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages		**EN744**	**EN2369A**	**EN3011**
V_{CBO}	Collector to Base Voltage	20 Volts	40 Volts	30 Volts
V_{CES}	Collector to Emitter Voltage		40 Volts	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	12 Volts	15 Volts	12 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	4.5 Volts	5.0 Volts
I_C	DC Collector Current	200 mA	200 mA	
I_C	Collector Current (10 μs Pulse)		500 mA	

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		EN744		**EN2369A**		EN3011				
SYMBOL	CHARACTERISTIC	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20							$I_C = 1.0$ mA	$V_{CE} = 0.25$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	40	120	**40**		30	120		**$I_C = 10$ mA**	**$V_{CE} = 0.35$ V**
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	20		20					$I_C = 10$ mA	$V_{CE} = 0.35$ V
h_{FE}	DC Pulse Current Gain (Note 5)				120				$I_C = 10$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)			30		25			$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20		20		12			$I_C = 100$ mA	$V_{CE} = 1.0$ V
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	12		**15**		12		**Volts**	**$I_C = 10$ mA**	**$I_B = 0$**
C_{obo}	Output Capacitance		5.0		4.0		4.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**			**5.0**		4.0			**$I_C = 10$ mA**	**$V_{CE} = 10$ V**
h_{fe}	High Frequency Current Gain (f = 100 MHz)	9.0						dB	$I_C = 10$ mA	$V_{CE} = 10$ V
τ_s	**Charge Storage Time Constant** (Note 6)		18		**13**		13	**ns**	**$I_C \approx I_{B1} \approx -I_{B2} \approx 10$ mA**	
t_{on}	**Turn On Time** (Note 6)		16		**12**			**ns**	**$I_C \approx 10$ mA, $I_{B1} \approx 3.0$ mA**	
t_{on}	Turn On Time (Note 6)		12					ns	$I_C \approx 100$ mA $I_{B1} \approx 40$ mA	
t_{off}	**Turn Off Time** (Note 6)		24		**18**			**ns**	**$I_C \approx 10$ mA $I_{B1} \approx 3.0$ mA $I_{B2} \approx -1.5$ mA**	
t_{off}	Turn Off Time (Note 6)		45					ns	$I_C \approx 100$ mA $I_{B1} \approx 40$ mA, $I_{B2} \approx -20$ mA	
t_{on}	Turn On Time (Note 6)						15	ns	$I_C \approx 30$ mA, $I_{B1} \approx 3.0$ mA	
t_{off}	Turn Off Time (Note 6)						20	ns	$I_C \approx 30$ mA, $I_{B1} \approx I_{B2} \approx 3.0$ mA	

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length ≤ 300 μs; duty cycle ≤ 2%.
(6) Measured on Sampling Scope. PW ≥ 200 ns

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS EN744 • EN2369A • EN3011

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	EN744 MIN.	EN744 MAX.	EN2369A MIN.	EN2369A MAX.	EN3011 MIN.	EN3011 MAX.	UNITS	TEST CONDITIONS	
V_{CE}(sat)	Collector Saturation Voltage				0.2		0.2	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat) (+100°C)	Collector Saturation Voltage		0.3		0.3			Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat) (+85°C)	Collector Saturation Voltage						0.3	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage				0.25		0.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE}(sat)	Collector Saturation Voltage				0.5		0.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{CE}(sat) (+100°C)	Collector Saturation Voltage		1.0					Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE}(sat)	Base Saturation Voltage	0.65	0.85	0.7	0.85	0.72	0.87	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat) (−55°C to +100°C)	Base Saturation Voltage			0.59	1.02			Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat) (−55°C)	Base Saturation Voltage		1.1					Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage				1.15		1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE}(sat)	Base Saturation Voltage		1.5		1.6		1.6	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE}(sat) (−55°C)	Base Saturation Voltage		1.6					Volts	$I_C = 100$ mA	$I_B = 10$ mA
I_{CES}	Collector Cutoff Current		1.0		0.4		0.4	µA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CES} (+85°C)	Collector Cutoff Current						20	µA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CBO}	Collector Cutoff Current		1.0					µA	$I_E = 0$	$V_{CB} = 20$ V
I_{CBO} (+100°C)	Collector Cutoff Current		25		25			µA	$I_E = 0$	$V_{CB} = 20$ V
I_{CEX} (+100°C)	Collector Cutoff Current		30					µA	$V_{CE} = 10$ V	$V_{BE} = 0.35$ V
I_{EBO}	Emitter Cutoff Current		10					µA	$I_C = 0$	$V_{EB} = 5.0$ V
BV_{EBO}	Emitter to Base Breakdown Voltage			4.5				Volts	$I_E = 10$ µA	$I_C = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0				5.0		Volts	$I_E = 100$ µA	$I_C = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	20		40		30		Volts	$I_C = 10$ µA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage			40		30		Volts	$I_C = 10$ µA	$V_{BE} = 0$

EN870 • EN871

NPN GENERAL PURPOSE AMPLIFIERS

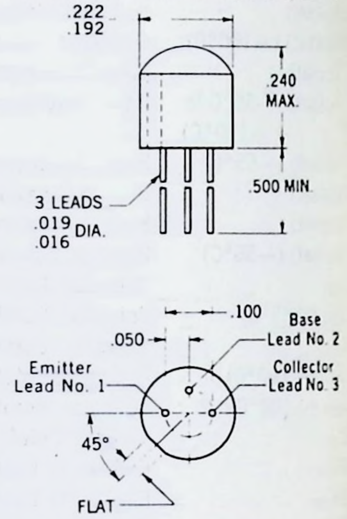
DOUBLE DIFFUSED SILICON PLANAR* TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N870 DATA SHEET

- **ELECTRICAL REPLACEMENTS FOR 2N870 AND 2N871**
- **HIGH VOLTAGE - - $LV_{CEO} = 60$ V (MIN)**
- **HIGH GAIN - - $h_{FE} = 100$-300 AT 150 mA**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0 31 gram Package
is electrically non-conductive materia

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65° to +125°C
Operating Junction Temperature	125°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.6 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.22 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

		EN870		EN871				
SYMBOL	CHARACTERISTIC	MIN	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	40	120	**100**	**300**		**$I_C = 150$ mA**	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	35					$I_C = 10$ mA	$V_{CE} = 10$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)	20					$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	20					$I_C = 0.1$ mA	$V_{CE} = 10$ V
$V_{BE}(sat)$	Base Saturation Voltage		0.9		0.9	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{CE}(sat)$	Collector Saturation Voltage		1.2		1.2	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage		1.3		1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{CE}(sat)$	Collector Saturation Voltage		5.0		5.0	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.5		3.0			$I_C = 30$ mA	$V_{CE} = 10$ V
C_{obo}	Output Capacitance		20		20	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{TE}	Emitter Transition Capacitance		85		85	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		100		100	nA	$I_E = 0$	$V_{CB} = 75$ V
$I_{CBO}(100°C)$	Collector Cutoff Current		15		15	μA	$I_E = 0$	$V_{CB} = 75$ V
BV_{CBO}	Collector to Base Breakdown Voltage	100		100		Volts	$I_C = 0$	$I_E = 0.1$ mA
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (Note 4)	**60**		**60**		**Volts**	**$I_C = 30$ mA** (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		Volts	$I_C = 0$	$I_E = 0.1$ mA
I_{EBO}	Emitter Cutoff Current		50		50	nA	$I_C = 0$	$V_{EB} = 5.0$ V
h_{ib}	Input Resistance (f = 1.0 kHz)	20	30	20	30	Ω	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ib}	Input Resistance (f = 1.0 kHz)	4.0	8.0	4.0	8.0	Ω	$I_C = 5.0$ mA	$V_{CB} = 10$ V

*Planar is a patented Fairchild proce

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FAIRCHILD TRANSISTORS EN870 • EN871

LECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	EN870 MIN.	EN870 MAX.	EN871 MIN.	EN871 MAX.	UNITS	TEST CONDITIONS	
h_{ob}	Output Conductance (f = 1.0 kHz)		0.5		0.5	μmho	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance (f = 1.0 kHz)		0.5		0.5	μmho	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{rb}	Voltage Feedback Ratio (f= 1.0 kHz)		1.25		5.0	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{rb}	Voltage Feedback Ratio (f= 1.0 kHz)		1.50		5.0	$\times 10^{-4}$	$I_C = 5.0$ mA	$V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	30	175	50	400		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	45	200	70	400		$I_C = 5.0$ mA	$V_{CE} = 10$ V

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 167°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal esistance of 455°C/Watt (derating factor of 2.2 mW/°C).

These ratings refer to a high current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

EN915 · EN916

NPN HIGH FREQUENCY AMPLIFIERS AND OSCILLATORS

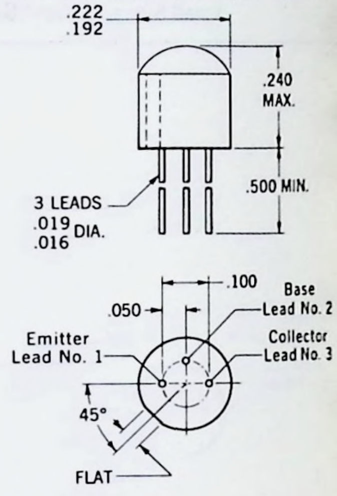
DIFFUSED SILICON PLANAR* TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N915 DATA SHEET

- **ELECTRICAL REPLACEMENTS FOR 2N915 AND 2N916**
- **HIGH VOLTAGE - - $LV_{CEO} = 50$ V (min.)**
- **HIGH GAIN - - $h_{FE} = 50 - 200$ AT 10 mA**
- **LOW CAPACITANCE - - $C_{obo} = 3.5$ pF (max.) AT 10 V**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outl



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +125°C
Operating Junction Temperature	125°C Maximum
Lead Temperature (Soldering, 10 Second Time Limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watts
at 25°C Ambient Temperature (Notes 2 and 3)	0.2 Watts

Maximum Voltages

		EN915	**EN916**
V_{CBO}	Collector to Base Voltage	70 Volts	45 Volts
V_{CEO}	**Collector to Emitter Voltage** (Note 4)	**50 Volts**	**25 Volts**
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	EN915 MIN.	EN915 MAX.	EN916 MIN.	EN916 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	**50**	**200**				**$I_C = 10$ mA**	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)			**50**	**200**		**$I_C = 10$ mA**	$V_{CE} = 1.0$ V
V_{BE}(sat)	Base Saturation Voltage		0.9		0.9	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage		1.0		0.5	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5		3.0			$I_C = 10$ mA	$V_{CE} = 15$ V
C_{obo}	**Output Capacitance**		**3.5**			**pF**	$I_E = 0$	**$V_{CB} = 10$**
C_{obo}	Output Capacitance				6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{ibo}	Input Capacitance		10		10	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		50			nA	$I_E = 0$	$V_{CB} = 60$ V
I_{CBO}(100°C)	Collector Cutoff Current		3.0			μA	$I_E = 0$	$V_{CB} = 60$ V
I_{CBO}	Collector Cutoff Current				50	nA	$I_E = 0$	$V_{CB} = 30$ V
I_{CBO}(100°C)	Collector Cutoff Current				10	μA	$I_E = 0$	$V_{CB} = 30$ V
BV_{CBO}	Collector to Base Breakdown Voltage	70				Volts	$I_C = 100$ μA	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage					Volts	$I_C = 10$ μA	$I_E = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage**	**50**				**Volts**	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Base to Emitter Breakdown Voltage	5.0				Volts	$I_E = 10$ μA	$I_C = 0$
$r_b'C_c$	Collector-Base Time Constant (f = 40 MHz)		300		300	ps	$I_C = 10$ mA	$V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	40	200	40	200		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50	250	50	250		$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
h_{ie}	Input Resistance (f = 1.0 kHz)		6.0		6.0	kΩ	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ie}	Input Resistance (f = 1.0 kHz)		2.0		2.0	kΩ	$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance (f = 1.0 kHz)		75		75	μmho	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance (f = 1.0 kHz)		125		125	μmho	$I_C = 5.0$ mA	$V_{CE} = 5.0$ V

*Planar is a patented Fairchild proces

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambi thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse conditions: Length = 300 μs; duty cycle = 1%.

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EN918

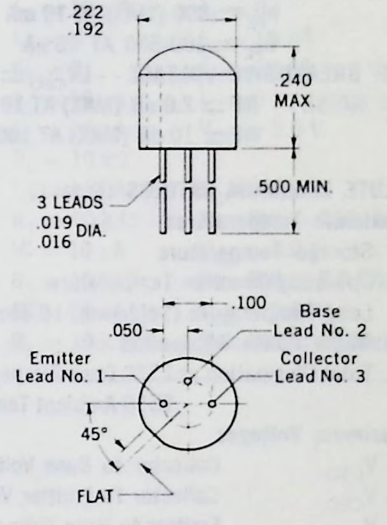
NPN ULTRA-HIGH FREQUENCY OSCILLATOR AND AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FOR POWER GAIN AND POWER OUTPUT TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N918 DATA SHEET

ELECTRICAL REPLACEMENT FOR 2N918
HIGH GAIN - - $G_{pe} = 15$ dB (min.) AT 200 MHz
- - $P_o = 30$ mW (min.) AT 500 MHz
LOW CAPACITANCE - - $C_{obo} = 1.7$ pF (max.) AT 10 V
LOW NOISE - - NF = 6.0 dB (max.) AT 60 MHz

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non conductive material

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 Second Time Limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL		MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20			$I_C = 3.0$ mA	$V_{CE} = 1.0$ V
V_{BE}(sat)	Base Saturation Voltage		1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage		0.4	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
C_{obo}	**Common-Base, Open-Circuit Output Capacitance**		**1.7**	**pF**	**$I_E = 0$**	**$V_{CB} = 10$ V**
C_{obo}	Common-Base, Open-Circuit Output Capacitance		3.0	pF	$I_E = 0$	$V_{CB} = 0$
C_{ibo}	Input Capacitance		2.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		50	nA	$I_E = 0$	$V_{CB} = 15$ V
I_{CBO}(100°C)	Collector Cutoff Current		1.0	μA	$I_E = 0$	$V_{CB} = 15$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	6.0			$I_C = 4.0$ mA	$V_{CE} = 10$ V
G_{pe}	**Available Power Gain (neutralized) (f = 200 MHz)**	**14**		**dB**	**$I_C = 6.0$ mA**	**$V_{CB} = 12$ V**
P_o	**Power Output f = 500 MHz)**	**30**		**mW**	**$I_C = 8.0$ mA**	**$V_{CB} = 15$ V**
η	Collector Efficiency (f = 500 MHz)	25		%	$I_C = 8.0$ mA	$V_{CB} = 15$ V
NF	**Noise Figure (f = 60 MHz; $R_g = 400\ \Omega$)**		**6.0**	**dB**	**$I_C = 1.0$ mA**	**$V_{CE} = 6.0$ V**
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 4)	15		Volts	$I_C = 3.0$ mA	$I_B = 0$
BV'_{CBO}	Collector to Base Breakdown Voltage	30		Volts	$I_C = 1.0\ \mu$A	$I_E = 0$
BV'_{EBO}	Emitter to Base Breakdown Voltage	3.0		Volts	$I_C = 0$	$I_E = 10\ \mu$A

*Planar is a patented Fairchild process.

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 500°C/Watt (derating factor of 5.0 mW/°C) Junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

Rating refers to a high current point where collector to emitter voltage is lowest.

FAIRCHILD
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EN930 · EN2484

NPN LOW LEVEL, LOW NOISE

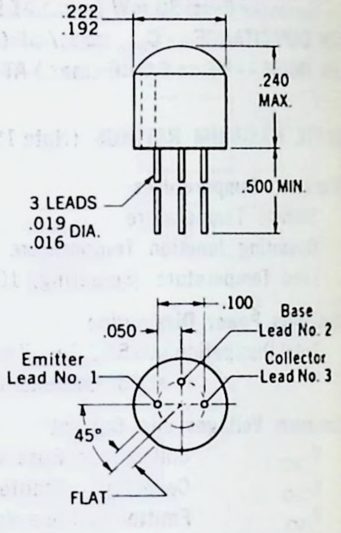
DOUBLE DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N2484 DATA SHEET

- **ELECTRICAL REPLACEMENT FOR 2N930 AND 2N2484**
- **HIGH GAIN - - $h_{FE} = 250$ (MIN) AT 1.0 mA**
  $h_{FE} = 800$ (MAX) AT 10 mA
  $h_{FE} = 100\text{-}500$ AT 10 μA
- **HIGH BREAKDOWN VOLTAGE - - $LV_{CEO} = 60$ V (MIN)**
- **LOW NOISE - - NF = 2.0 dB (MAX) AT 10 kHz**
  NF = 10 dB (MAX) AT 100 Hz

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +125°C
Operating Junction Temperature	125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages

		EN930	EN2484
V_{CBO}	Collector to Base Voltage	45 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	6.0 Volts
I_C	Collector Current	30 mA	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	EN930 MIN.	EN930 MAX.	EN2484 MIN.	EN2484 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)		600		**800**		$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{FE}	**DC Current Gain**			**250**			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	150		200			$I_C = 500\ \mu$A	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain			175			$I_C = 100\ \mu$A	$V_{CE} = 5.0$ V
h_{FE}	**DC Current Gain**	100	300	**100**	**500**		$I_C = 10\ \mu$A	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain			30			$I_C = 1.0\ \mu$A	$V_{CE} = 5.0$ V
h_{FE}(−55°C)	DC Current Gain	20		20			$I_C = 10\ \mu$A	$V_{CE} = 5.0$ V
V_{BE}	Base-Emitter Voltage (Note 5)	0.6	1.0			Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{BE}(on)	Base-Emitter On Voltage			0.5	0.7	Volts	$I_C = 100\ \mu$A	$V_{CE} = 5.0$ V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		1.0			Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{CE}(sat)	Collector Saturation Voltage				.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
h_{fe}	High Frequency Current Gain (f = 5.0 MHz)			3.0			$I_C = 50\ \mu$A	$V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 30 MHz)	1.0		2.0			$I_C = 500\ \mu$A	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	150	600	150	900		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance (f = 1.0 kHz)	25	32	25	32	Ω	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance (f = 1.0 kHz)		1.0			µmho	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{rb}	Voltage Feedback Ratio (f = 1.0 kHz)		600			x10⁻⁶	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ie}	Input Resistance (f = 1.0 kHz)			3.5	24	kΩ	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance (f = 1.0 kHz)				40	µmhos	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio				800	x10⁻⁶	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
I_{CBO}	Collector-Base Cutoff Current		50		50	nA	$I_E = 0$	$V_{CB} = 45$ V
I_{CBO}(100°C)	Collector Cutoff Current				10	µA	$I_E = 0$	$V_{CB} = 45$ V
I_{CES}	Collector-Emitter Cutoff Current		50			nA	$V_{CE} = 45$ V	$V_{EB} = 0$
I_{CES}(100°C)	Collector-Emitter Cutoff Current		10			µA	$V_{CE} = 45$ V	$V_{EB} = 0$

*Planar is a patented Fairchild proc

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS EN930 • EN2484

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	EN930 MIN.	EN930 MAX.	EN2484 MIN.	EN2484 MAX.	UNITS	TEST CONDITIONS	
I_{EBO}	Emitter-Base Cutoff Current		50		50	nA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEO}	Collector-Emitter Cutoff Current		50		50	nA	$I_B = 0$	$V_{CE} = 5.0$ V
C_{obo}	Output Capacitance		8.0		6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{TE}	Emitter Transition Capacitance				6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	45		**60**		**Volts**	**$I_C = 10$ mA**	**$I_B = 0$**
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0				Volts	$I_C = 0$	$I_E = 10\ \mu A$
BV_{EBO}	Emitter to Base Breakdown Voltage			6.0		Volts	$I_C = 0$	$I_E = 10\ \mu A$
BV_{CBO}	Collector to Base Breakdown Voltage	45		60		Volts	$I_C = 10\ \mu A$	$I_E = 0$
NF	Wide Band Noise Figure (BW = 15.7 kHz; 3dB pts at 10 Hz and 10 kHz)		3.0		3.0	dB	$I_C = 10\ \mu A$ $R_S = 10\ k\Omega$	$V_{CE} = 5.0$ V
NF	Narrow Band Noise Figure (f = 1.0 kHz)				3.0	dB	$I_C = 10\ \mu A$ $R_S = 10\ k\Omega$	$V_{CE} = 5.0$ V Pwr. BW = 200 Hz
NF	**Narrow Band Noise Figure (f = 10 kHz)**				**2.0**	**dB**	**IC = 10 μA** **$R_S = 10\ k\Omega$**	**$V_{CE} = 5.0$ V** **Pwr. BW = 2.0 kHz**
NF	**Narrow Band Noise Figure (f = 100 Hz)**				**10**	**dB**	**IC = 10 μA** **$R_S = 10\ k\Omega$**	**$V_{CE} = 5.0$ V** **Pwr. BW = 20 Hz**

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) These ratings refer to a high-current point where collector to emitter voltage is lowest.
(5) Pulse conditions: Length = 300 μs; duty cycle = 1%.

SE1001 · SE1002

NPN AM/FM TYPE

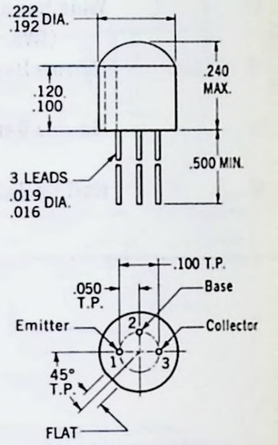
DIFFUSED SILICON PLANAR TRANSISTORS

The SE 1001 and SE 1002 are NPN silicon PLANAR transistors designed specifically for A.M.-F.M. receiver applications. They feature high power gain, high beta, and low collector cutoff current in a solid package designed to give maximum mechanical support to the transistor chip.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Operating Junction Temperature	125°C Maximum
Storage Temperature	−55°C to +125°C
Soldering Temperature (10 sec time limit)	260°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Note 2]	0.5 Watt
at 65°C Case Temperature [Note 2]	0.3 Watt
at 25°C Ambient Temperature [Note 2]	0.2 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	45 Volts
V_{CEO} Collector to Emitter Voltage [Note 3]	45 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

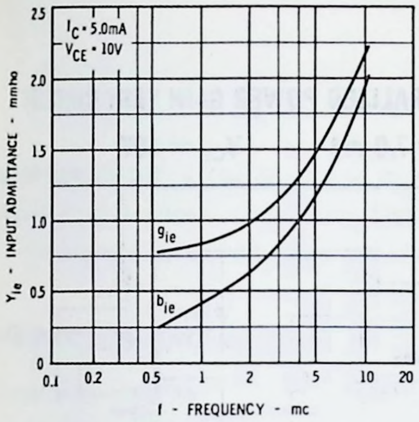
SYMBOL	CHARACTERISTIC	SE 1001 Min.	SE 1001 Typ.	SE 1001 Max.	SE 1002 Min.	SE 1002 Typ.	SE 1002 Max.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 4]	40		160	100		400		$I_C = 10$ mA	$V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current			0.5			0.5	μA	$I_E = 0$	$V_{CB} = 30$ V
I_{CBO} (65°C)	Collector Cutoff Current			5.0			5.0	μA	$I_E = 0$	$V_{CB} = 30$ V
C_{ob}	Output Capacitance			3.5			3.5	pf	$I_E = 0$	$V_{CB} = 10$ V
NF	Spot Noise Figure [Note 5]		4.0			4.0		db	$I_C = 3.0$ mA	$V_{CE} = 10$ V
A_{pg}	Available Power Gain (neutralized) (f = 10.7 mc)		32			32		db	$I_C = 7.0$ mA	$V_{CE} = 10$ V
A_{pg}	Available Power Gain (neutralized) (f = 455 kc)		55			55		db	$I_C = 3.0$ mA	$V_{CE} = 10$ V
G_C	Conversion Gain (f = 108 mc to 10.7 mc)		20			20		db	$I_C = 7.0$ mA	$V_{CE} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	45			45			Volts	$I_C = 0.1$ mA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 3]	45			45			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	$I_E = 0.1$ mA	$I_C = 0$
h_{fe}	High Frequency Current Gain (f = 100 mc)	2.0	3.5		2.0	3.5			$I_C = 10$ mA	$V_{CE} = 15$ V

NOTES:

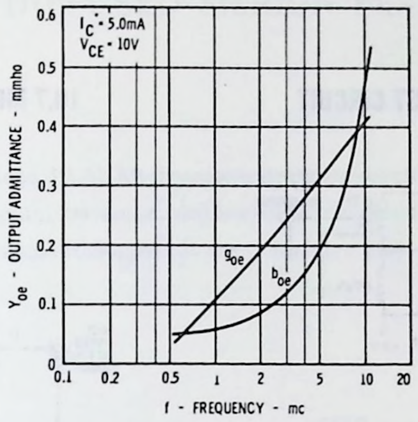
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(5) $f = 1.0$ mc; $R_s = 300\Omega$.
(6) Reference: Gertzis, S. and Basselaers, R.— Characterization of R.F. Transistors for AM/FM Radio Applications. IRE, PGBTR, Trans., Nov. 1962.

TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

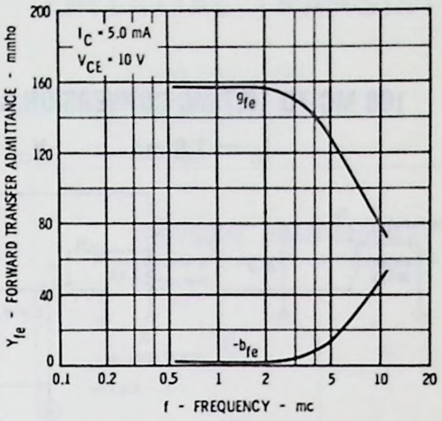
INPUT ADMITTANCE VERSUS FREQUENCY—OUTPUT SHORT CIRCUIT



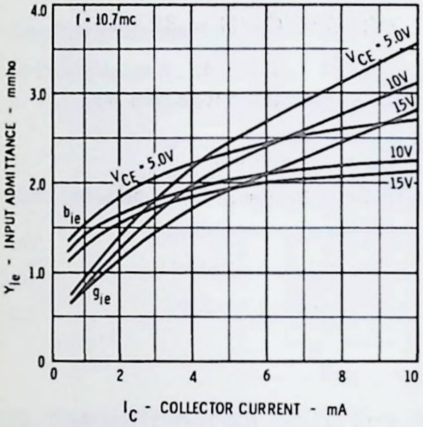
OUTPUT ADMITTANCE VERSUS FREQUENCY—INPUT SHORT CIRCUIT



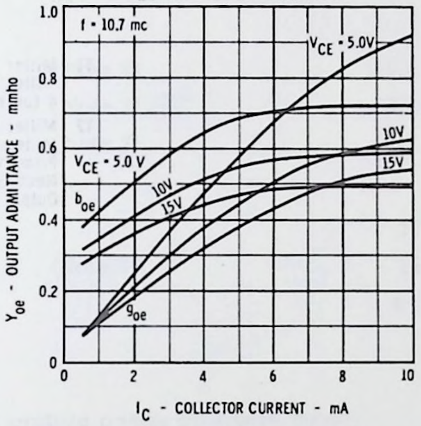
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY—OUTPUT SHORT CIRCUIT



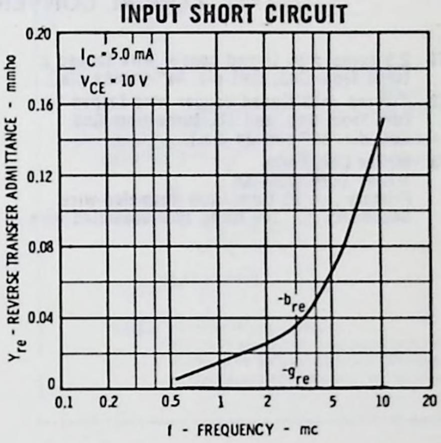
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT—OUTPUT SHORT CIRCUIT



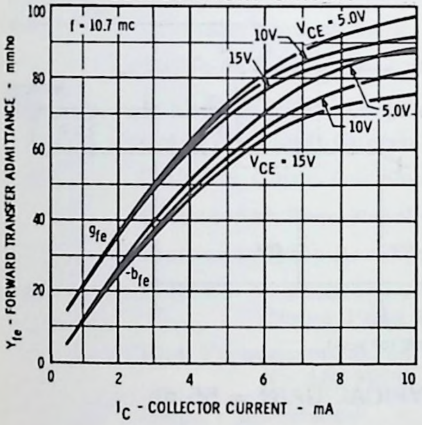
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT—INPUT SHORT CIRCUIT



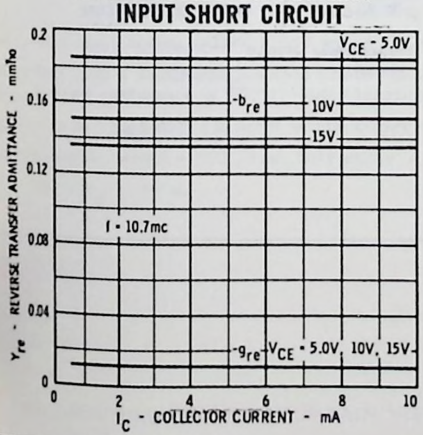
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY—INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT—OUTPUT SHORT CIRCUIT

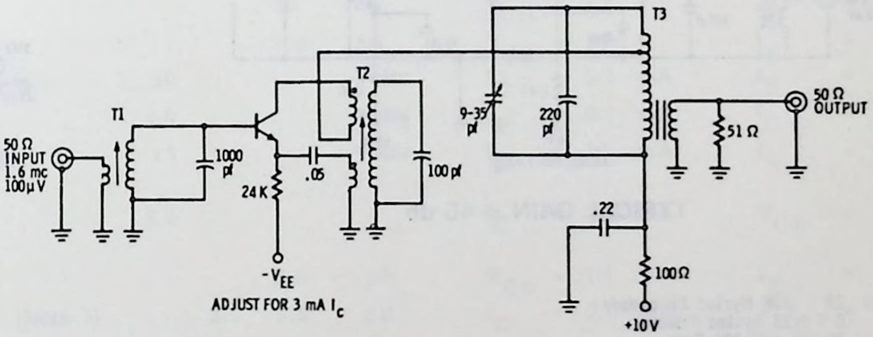


REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT—INPUT SHORT CIRCUIT



1.6 MC TO 455 KC AUTODYNE CONVERSION GAIN TEST CIRCUIT

I_C = 2.0-3.0 mA V_{CE} = 10V



TYPICAL GAIN = 42 db

T1 Miller Coil Form
Miller Slug #30-106 Core
Primary . . . 6 T #28 enameled wire
Secondary . . . 28 T #36 enameled wire

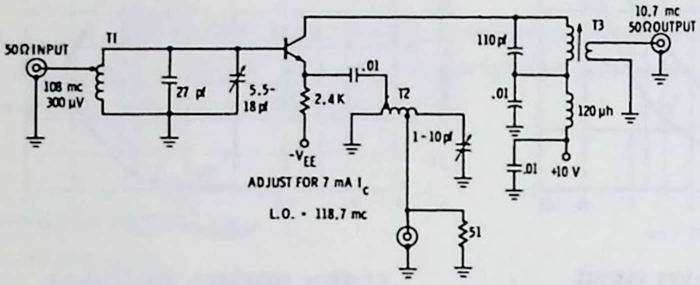
T2 Miller Coil Form
Miller Core #30-106

4 Turns #28 Enameled Wire
1½ Turns #28 Enameled Wire
60 Turns #36 Enameled Wire

T3 Miller #2032 455 KC Transformer
Center Core only

108 MC TO 10.7 MC CONVERSION GAIN TEST CIRCUIT

$I_C = 7.0\ \text{mA} \qquad V_{CE} = 10\text{V}$


50Ω INPUT
108 mc
300 μV
T1
27 pf
5.5-
18 pf
2.4 K
-V_EE
ADJUST FOR 7 mA I_C
.01
T2
1-10 pf
L.O. - 118.7 mc
51
110 pf
.01
.01
T3
120 μh
+10 V
10.7 mc
50Ω OUTPUT

TYPICAL CONVERSION GAIN = 20 db

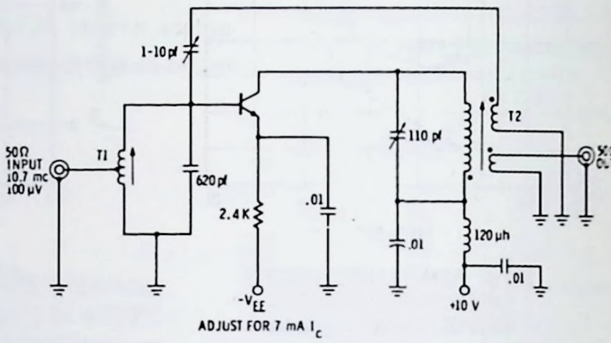
T1 2.5 turns #16 tinned copper wire tapped 2 turns from Gnd. Coil dia. 3/8″ (inside dia.).

T2 4 turns #16 tinned copper wire tapped 3/4 turn from Gnd. and 1 1/4 turns from Gnd. Coil dia. 1/4″ (inside dia.).

T3 Miller Coil Form
Miller Core #30-106
Primary . . . 10 turns #36 enameled wire.
Secondary . . . 1 1/3 turns #28 enameled wire.

10.7 MC NEUTRALIZED POWER GAIN TEST CIRCUIT

$I_C = 7.0\ \text{mA} \qquad V_{CE} = 10\text{V}$


50Ω
INPUT
10.7 mc
100 μV
T1
1-10 pf
620 pf
2.4 K
-V_EE
ADJUST FOR 7 mA I_C
.01
110 pf
.01
T2
120 μh
.01
+10 V
50Ω
OUTPUT

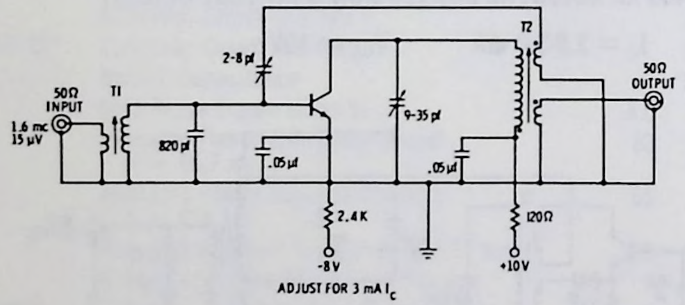
TYPICAL GAIN = 32 db

T1 Miller Coil Form
Miller Core #30-106
4 turns #28 enameled wire tapped 1.5 turns from Gnd.

T2 Miller Coil Form
Miller Core #30-106
Primary . . . 10 turns #36 enameled wire.
Neut. Sec. . . . 5 turns #36 enameled wire (Bifilar).
Output Sec. . . . 1.33 turns #28 enameled wire (Overwind).

NEUTRALIZED A.M. R.F. AMPLIFIER TEST CIRCUIT

$I_C = 3.0\ \text{mA} \qquad V_{CE} = 10\text{V}$


50Ω
INPUT
1.6 mc
15 μV
T1
820 pf
2-8 pf
.05 μf
2.4 K
-8 V
ADJUST FOR 3 mA I_C
9-35 pf
.05 μf
T2
120Ω
+10V
50Ω
OUTPUT

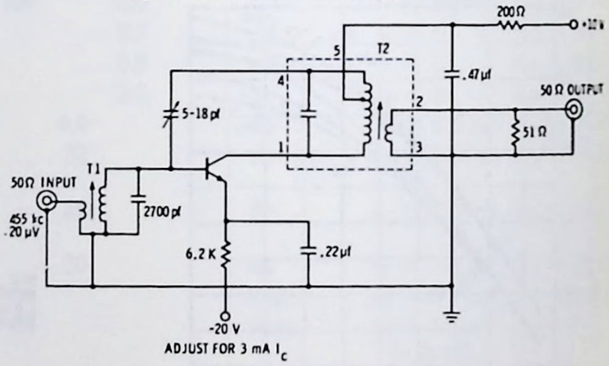
TYPICAL GAIN = 46 db

T1 28 T #36 Nyclad Secondary
6 T #28 Nyclad Primary
Miller #80-106 Core

T2 120 T #40 S.S. Enl. Primary
40 T #40 S.S. Enl. Neut. Sec.
7 T #28 Nyclad Output Sec., wave wound
Bifilar with cold end of Primary.

455 KC NEUTRALIZED A.M. I.F. AMPLIFIER TEST CIRCUIT

$I_C = 3.0\ \text{mA} \qquad V_{CE} = 10\text{V}$


50Ω INPUT
455 kc
20 μV
T1
2700 pf
5-18 pf
6.2 K
.22 μf
-20 V
ADJUST FOR 3 mA I_C
T2
5
4
1
2
3
.47 μf
200Ω
+10 V
50 Ω OUTPUT
51 Ω

TYPICAL GAIN = 55 db

T1 13 T Primary #26 Nyclad
54 T Secondary #36 Nyclad } Miller #30-106 Core
.043 mh

T2 Miller Min. I.F. Transformer #2032.

SE 1010

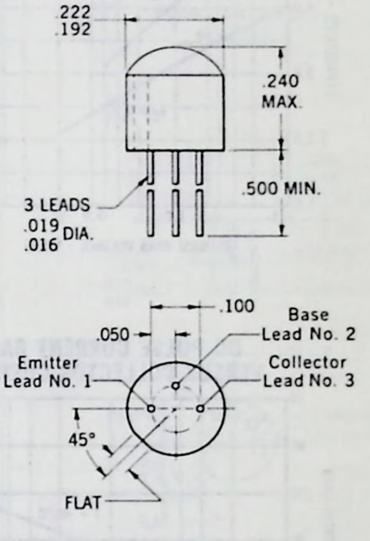
NPN LOW-NOISE RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

ERAL DESCRIPTION - The SE1010 is an NPN silicon PLANAR transistor designed specifically AM receiver applications. It features high power gain, low noise, and low collector cutoff cur- in a solid package designed to give maximum mechanical support to the transistor chip.

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

OLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures

Storage Temperature		-55°C to +125°C
Operating Junction Temperature		125°C Maximum
Lead Temperature (Soldering, 10 sec time limit)		260°C Maximum

aximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Note 2)	0.5 Watt
at 65°C Case Temperature	(Note 2)	0.3 Watt
at 25°C Ambient Temperature	(Note 2)	0.2 Watt

aximum Voltages

V_{CBO}	Collector to Base Voltage		30 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 3)	15 Volts
V_{EBO}	Emitter to Base Voltage		4.0 Volts

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

bol	Characteristic		Min	Typ	Max	Units	Test Conditions	
E	DC Pulse Current Gain	(Note 4)	20	35			I_C = 2.0 mA	V_{CE} = 10 V
$_E$(sat)	Collector Saturation Voltage				0.3	Volts	I_C = 10 mA	I_B = 1.0 mA
$_E$(sat)	Base Saturation Voltage				0.97	Volts	I_C = 10 mA	I_B = 1.0 mA
O	Collector Cutoff Current				50	nA	V_{CB} = 15 V	I_E = 0
O(65°C)	Collector Cutoff Current				500	nA	V_{CB} = 15 V	I_E = 0
CBO	Collector to Base Breakdown Voltage		30			Volts	I_C = 0.1 mA	I_E = 0
EBO	Emitter to Base Breakdown Voltage		4.0			Volts	I_E = 0.1 mA	I_C = 0
EO(sust)	Collector to Emitter Sustaining Voltage (Notes 3 and 4)		15			Volts	I_C = 10 mA	I_B = 0
	High Frequency Current Gain (f = 100 MHz)		2.0				I_C = 2.0 mA	V_{CE} = 10 V
	Output Capacitance				3.5	pF	V_{CB} = 10 V	I_E = 0
	Noise Figure	(Note 5)		3.7	5.5	dB	I_C = 2.0 mA	V_{CE} = 10 V

S:

* Planar is a patented Fairchild process.

hese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

hese ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to mbient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).

ailing refers to a high current point where collector to emitter voltage is lowest.

ulse Conditions: length = 300 μsec; duty cycle = 1%.

= 1.0 MHz R_S = 50 Ω.

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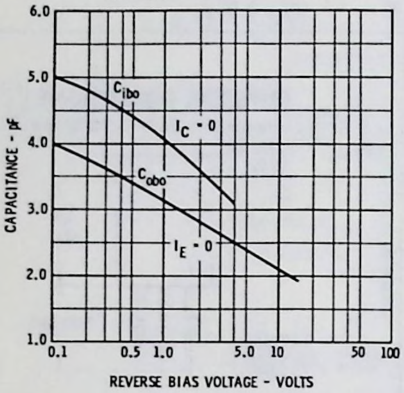
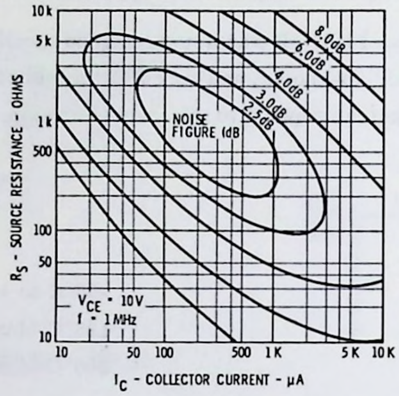
TYPICAL ELECTRICAL CHARACTERISTICS

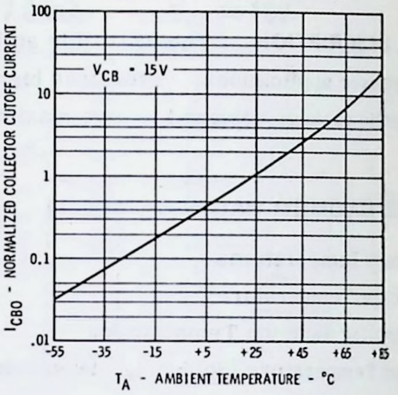
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



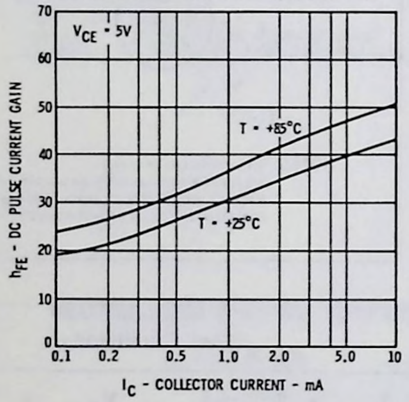
CONTOURS OF SPOT NOISE FIGURE



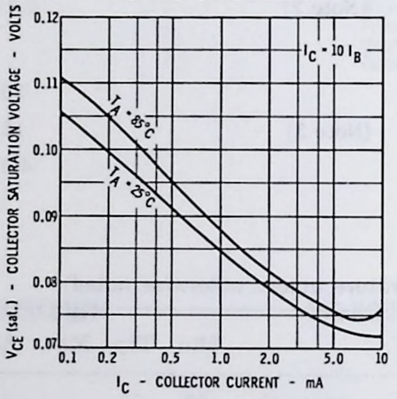
NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

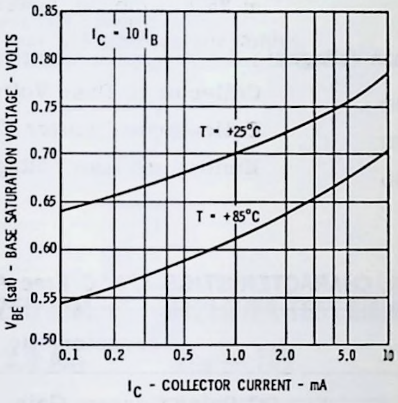
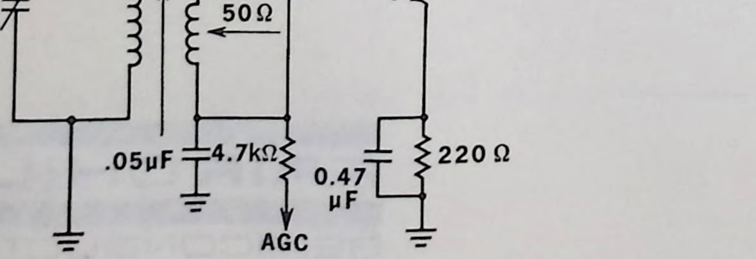
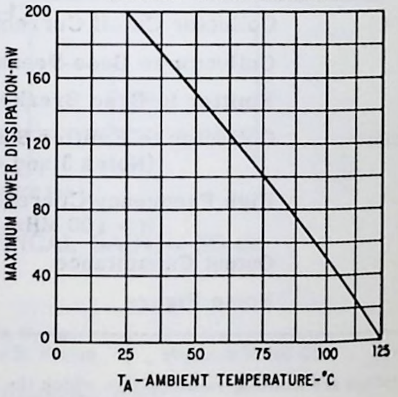


FIG. 1. R-F STAGE FOR MOBILE RADIO



MAXIMUM POWER DISSIPATION VERSUS TEMPERATURE

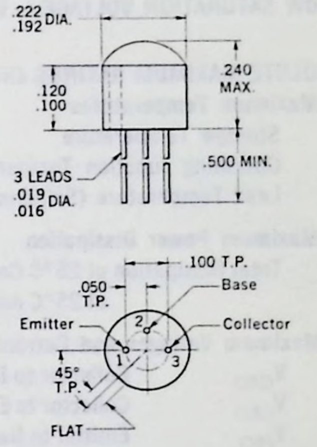


The problem of high SNR with low cross modulation is alleviated with the SE1010 in r-f stages. Noise figure remains satisfactory even when the input inductance is tapped at a very low-impedance point. Cross modulation is reduced because of the very low-level signal applied to the transistor base. The circuit shown in Fig. 1 demonstrated a NF of 5 dB with 3 mA collector current, 31 dB gain, and 1% cross modulation with 100 µV desired input signal at 1 MHz and 23 mV undesired input signal at 1.04 MHz.

SE2001 · SE2002
NPN GENERAL PURPOSES
DIFFUSED SILICON PLANAR* TRANSISTORS

GENERAL DESCRIPTION - The Fairchild SE2001 and SE2002 are NPN silicon PLANAR transistors in a solid package designed to give maximum mechanical support to the transistor chip. They are designed for use in audio and video amplifiers, sync circuits, stereo multiplex, and audio pre-amplifiers.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	-55°C to +125°C
Operating Junction Temperature	125°C Maximum
Soldering Temperature (10 sec time limit)	260°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Note 2]	0.5 Watt
at 65°C Case Temperature [Note 2]	0.3 Watt
at 25°C Ambient Temperature [Note 2]	0.2 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	35 Volts
V_{CEO} Collector to Emitter Voltage [Note 3]	20 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain [Note 4] **SE2001**	40	160		$I_C = 10$ mA $V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain [Note 4] **SE2002**	100	400		$I_C = 10$ mA $V_{CE} = 1.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0			$I_C = 10$ mA $V_{CE} = 10$ V
V_{CE}(sat)	Collector Saturation Voltage		0.7	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage		0.9	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
I_{CBO}	Collector Cutoff Current		0.5	μA	$I_E = 0$ $V_{CB} = 15$ V
I_{CBO} (65°C)	Collector Cutoff Current		5.0	μA	$I_E = 0$ $V_{CB} = 15$ V
C_{obo}	Output Capacitance		6.0	pF	$I_E = 0$ $V_{CB} = 10$ V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage [Notes 3 and 4]	20		Volts	$I_C = 10$ mA (pulsed) $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	35		Volts	$I_C = 0.1$ mA $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		Volts	$I_C = 0$ $I_E = 0.1$ mA

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

EN2219 · EN222

NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHE

DOUBLE DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTO

FOR TEST CIRCUITS ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N3299 DATA SH

- **ELECTRICAL REPLACEMENTS FOR 2N2219 AND 2N2222**
- **HIGH GAIN - - $h_{FE} = 100\text{-}300$ AT 150 mA**
  $h_{FE} = 35$ (MIN) AT 100 μA
  $h_{FE} = 30$ (MIN) AT 500 mA
- **MEDIUM VOLTAGE - - $LV_{CEO} = 30$ V (MIN)**
- **HIGH FREQUENCY - - $f_T = 250$ MHz (MIN) AT 20 mA**
- **LOW SATURATION VOLTAGE - - V_{CE}(sat) = 0.4 V(MAX) AT 150 mA**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +125°C
Operating Junction Temperature	−65°C to +125°C
Lead Temperature (Soldering, 10 second time limit)	260° Maximum

Maximum Power Dissipation		**EN2219**	**EN2222**
Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.7 Watt	0.5 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.35 Watt	0.2 Watt

Maximum Voltages and Current

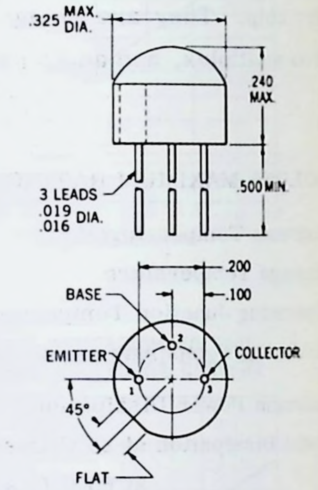
V_{CBO}	Collector to Base Voltage		60 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage		5.0 Volts
I_C	Collector Current		800 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	**100**	**300**		**$I_C = 150$ mA**	**$V_{CE} = 10$ V**
h_{FE}	DC Pulse Current Gain (Note 5)	50			$I_C = 150$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Current Gain	75			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	50			$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{FE}	**DC Current Gain**	**35**			**$I_C = 0.1$ mA**	**$V_{CE} = 10$ V**
h_{FE}	**DC Pulse Current Gain** (Note 5)	**30**			**$I_C = 500$ mA**	**$V_{CE} = 10$ V**
V_{CE}(sat)	**Collector Saturation Voltage** (pulsed, note 5)		**0.4**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
V_{CE}(sat)	Collector Saturation Voltage (pulsed, note 5)		1.6	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, note 5)		1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, note 5)		2.6	Volts	$I_C = 500$ mA	$I_B = 50$ mA
h_{fe}	High Frequency Current Gain(f = 100 MHz)	2.5			$I_C = 20$ mA	$V_{CE} = 20$ V
f_T	**Gain-Bandwidth Product** (f = 100 MHz)	**250**		**MHz**	**$I_C = 20$ mA**	**$V_{CE} = 20$ V**
I_{CBO}	Collector Cutoff Current		50	nA	$I_E = 0$	$V_{CB} = 50$ V
I_{CBO}(100°C)	Collector Cutoff Current		10	μA	$I_E = 0$	$V_{CB} = 50$ V
I_{EBO}	Emitter Cutoff Current		50	nA	$I_C = 0$	$V_{EB} = 3.0$ V
C_{obo}	Output Capacitance		8.0	pF	$I_E = 0$	$V_{CB} = 10$ V

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-105) outline

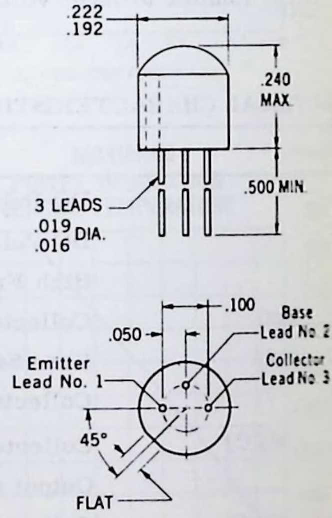


NOTES All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0 66 gram

EN2219

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outl



NOTES: All dimensions in inches
All leads electrically isolated from ca
Package weight is 0 31 gram Package
is electrically non conductive mater

EN2222

*Planar is a patented Fairchild proc

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ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
$R_{e(hie)}$	Real Part of Common-Emitter High-Frequency Input Impedance (f = 300 MHz)		60	Ω	$I_C = 20$ mA	$V_{CE} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	60		Volts	$I_C = 10\ \mu A$	$I_E = 0$
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**30**		Volts	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	$I_E = 10\ \mu A$	$I_C = 0$

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/Watt (derating factor of 7.0 mW/°C); junction to ambient thermal resistance of 286°C/Watt (derating factor of 3.5 mW/°C) for the EN2219. For the EN2222 junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

This rating refers to a high-current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle ≤2%.

EN2894A

PNP HIGH SPEED SATURATED SWITCH

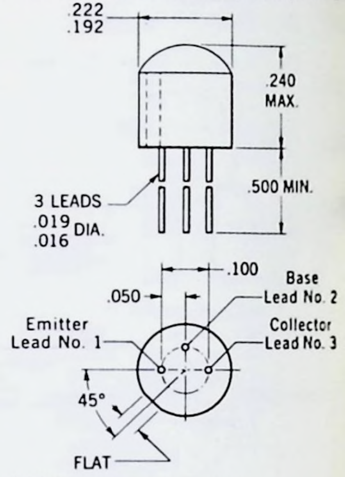
DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTOR

For test circuits and additional design information see Fairchild 2N2894A data sheet.

- **ELECTRICAL REPLACEMENT for 2N2894 and 2N2894A**
- **FAST SWITCHING . . . . $t_{on} = 20$ ns (MAX) @ 30 mA**
  . . . . $t_{off} = 25$ ns (MAX) @ 30 mA
  . . . . $\tau_s = 20$ ns (MAX) @ 10 mA
- **HIGH FREQUENCY . . . . $f_T = 800$ MHz (MIN) @ 30 mA**
- **LOW CAPACITANCE . . . . $C_{obo} = 4.5$ pF (MAX) @ 5 V**
- **LOW SATURATION VOLTAGE . . . . $V_{CE(SAT)} = 0.13$ V (MAX) @ $I_C = 10$ mA**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outl



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive materi

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 seconds time limit)	+260°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.2 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	−12 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	−12 Volts
V_{EBO} Emitter to Base Voltage	−4.5 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
t_{on}	**Turn On Time**		**10**	**20**	**ns**	**$I_C \approx 30$ mA**	**$I_{B1} \approx 3.0$ mA**
t_{off}	**Turn Off Time**		**15**	**25**	**ns**	**$I_C \approx 30$ mA**	**$I_{B1} \approx I_{B2} \approx 3.0$ mA**
t_{on}	Turn On Time		23	60	ns	$I_C \approx 30$ mA	$I_{B1} \approx 1.5$ mA
t_{off}	Turn Off Time		13	35	ns	$I_C \approx 30$ mA	$I_{B1} \approx I_{B2} \approx 1.5$ mA
τ_s	**Charge Storage Time Constant**		**15**	**20**	**ns**	**$I_C \approx I_{B1} \approx I_{B2} \approx 10$ mA**	
V_{CE} (sat)	**Pulsed Collector-Emitter Saturation Voltage** [Note 5]		**−0.08**	**−0.13**	**Volts**	**$I_C = 10$ mA**	**$I_B = 1.0$ mA**
V_{CE} (sat)	Pulsed Collector-Emitter Saturation Voltage [Note 5]		−0.12	−0.19	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE} (sat)	Pulsed Collector-Emitter Saturation Voltage [Note 5]		−0.28	−0.45	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage [Note 5]	−0.78	−0.82	−0.92	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage [Note 5]	−0.85	−0.93	−1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage [Note 5]	−1.0	−1.14	−1.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**8.0**	**12**			**$I_C = 30$ mA**	**$V_{CE} = -10$ V**
C_{obo}	**Output Capacitance**		**3.3**	**4.5**	**pF**	**$I_E = 0$**	**$V_{CB} = -5.0$ V**
C_{ibo}	Input Capacitance		4.7	6.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
I_{CES}	Collector Reverse Current		0.2	50	nA	$V_{BE} = 0$	$V_{CE} = -10$ V
I_{CBO} (100°C)	Collector Cutoff Current		0.05	10	μA	$I_E = 0$	$V_{CB} = -10$ V
V_{CEO} (sust)	**Collector-Emitter Sustaining Voltage** [Notes 4 and 5]	**−12**			**Volts**	**$I_C = 10$ mA** (pulsed)	**$I_B = 0$**
BV_{CBO}	Collector-Base Breakdown Voltage	−12			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{CES}	Collector-Emitter Breakdown Voltage	−12			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{EBO}	Emitter-Base Breakdown Voltage	−4.5			Volts	$I_C = 0$	$I_E = 100$ μA
h_{FE}	DC Pulse Current Gain [Note 5]	20	44			$I_C = 1.0$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	53			$I_C = 10$ mA	$V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	40	63	120		$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	**DC Pulse Current Gain** [Note 5]	**30**	**55**			**$I_C = 100$ mA**	**$V_{CE} = -1.0$ V**
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	20	38			$I_C = 30$ mA	$V_{CE} = -0.5$ V

* Planar is a patented Fairchild Pr

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient ther resistance of 500°C/watt (derating factor of 2.0 mW/°C).

(4) This rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

EN2905 · EN2907

PNP HIGH-SPEED SWITCHES AND CORE DRIVERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N2905 DATA SHEET

ELECTRICAL REPLACEMENTS FOR 2N2905 and 2N2907

LOW SATURATION VOLTAGE . . . . $V_{CE(sat)}$ = 0.4 V (MAX) @ 150 mA
FAST SWITCHING . . . . t_{on} = 50 ns (MAX) @ 150 mA
. . . . t_{off} = 110 ns (MAX) @ 150 mA
HIGH BETA . . . . h_{FE} = 75 (MIN) @ 10 mA
. . . . h_{FE} = 100–300 @ 150 mA
HIGH BREAKDOWN VOLTAGE · · · · LV_{CEO} = 40 V (MIN) @ 10 mA

SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (soldering, 10 second time limit)	+260°C Maximum

Maximum Power Dissipation [Notes 2 and 3]

	EN2905	**EN2907**
Total Dissipation at 25°C Case Temperature	0.7 Watt	0.5 Watt
at 25°C Free Air Temperature	0.3 Watt	0.2 Watt

Maximum Voltages and Current

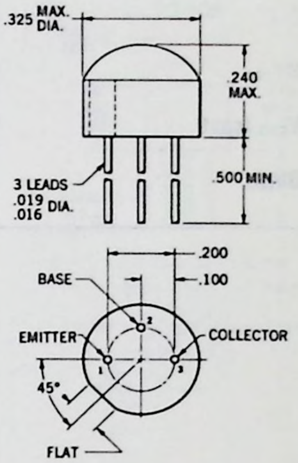
V_{CBO}	Collector to Base Voltage	−60 Volts	−60 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−40 Volts	−40 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C	Collector Current [Note 2]	600 mA	600 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	35			I_C = 0.1 mA	V_{CE} = −10 V
h_{FE}	DC Current Gain	50			I_C = 1.0 mA	V_{CE} = −10 V
h_{FE}	**DC Current Gain**	**75**			**I_C = 10 mA**	**V_{CE} = −10 V**
h_{FE}	**DC Pulse Current Gain** [Note 5]	**100**	**300**		**I_C = 150 mA**	**V_{CE} = −10 V**
h_{FE}	DC Pulse Current Gain [Note 5]	30			I_C = 500 mA	V_{CE} = −10 V
V_{CE}(sat)	**Collector Saturation Voltage** [pulsed, see Note 5]		**−0.4**	**Volts**	**I_C = 150 mA**	**I_B = 15 mA**
V_{CE}(sat)	Collector Saturation Voltage [pulsed, see Note 5]		−1.0	Volts	I_C = 300 mA	I_B = 30 mA
V_{BE}(sat)	Base Saturation Voltage [pulsed, see Note 5]		−1.3	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage [pulsed, see Note 5]		−2.0	Volts	I_C = 300 mA	I_B = 30 mA
t_d	**Turn-On Delay Time**		**10**	**ns**	**I_{CS} = 150 mA**	**I_{B1} = 15 mA**
t_r	**Rise Time**		**40**	**ns**	**I_{CS} = 150 mA**	**I_{B1} = 15 mA**
t_s	**Storage Time**		**80**	**ns**	**I_{CS} = 150 mA, I_{B1} = I_{B2} = 15 mA**	
t_f	**Fall Time**		**30**	**ns**	**I_{CS} = 150 mA, I_{B1} = I_{B2} = 15 mA**	

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-105) outline

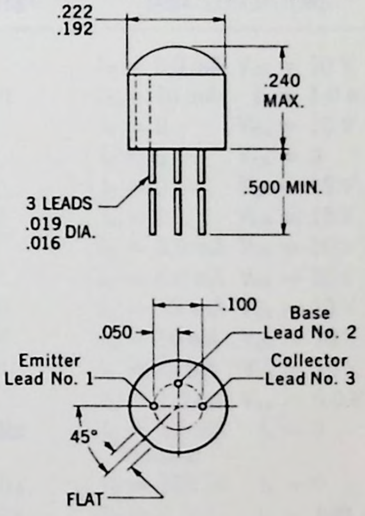


NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

EN2905

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

EN2907

* Planar is a patented Fairchild process.

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FAIRCHILD PNP HIGH-SPEED SWITCHES AND CORE DRIVERS

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.5			$I_C = 50$ mA	$V_{CE} = -3.0$ V
I_{CBO}	Collector Cutoff Current		50	nA	$I_E = 0$	$V_{CB} = -50$ V
I_{CBO} (100°C)	Collector Cutoff Current		20	μA	$I_E = 0$	$V_{CB} = -50$ V
I_{CEX}	Collector Reverse Current		50	nA	$V_{CE} = -30$ V	$V_{BE} = +0.5$ V
I_B	Base Current		50	nA	$V_{CE} = -30$ V	$V_{BE} = +0.5$ V
C_{ob}	Output Capacitance (f = 100 kHz)		8.0	pF	$I_E = 0$	$V_{CB} = -10$ V
C_{TE}	Emitter Transition Capacitance (f = 100 kHz)		30	pF	$I_C = 0$	$V_{EB} = -2.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	−60		Volts	$I_C = 10$ μA	$I_B = 0$
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	**−40**		**Volts**	**$I_C = 10$ mA (pulsed)**	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		Volts	$I_E = 10$ μA	$I_C = 0$

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/watt (derating factor of 7.0 mW/°C) for the EN2905 and 200°C/wat (derating factor of 5.0 mW/°C) for the EN2907; junction to ambient thermal resistance of 333°C/watt (derating factor of 3.0 mW/°C) for the EN2905 and 500°C/watt (derating factor 2.0 mW/°C) for the EN2907.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

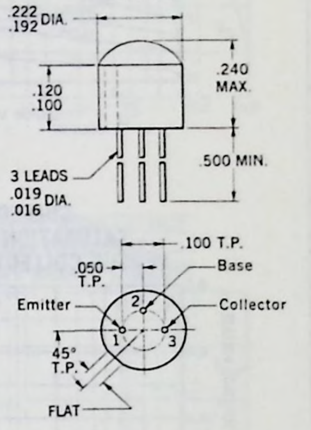
SE3001 · SE3002

NPN TV-FM RECEIVER

DIFFUSED SILICON PLANAR TRANSISTORS

he SE3001 and SE3002 are NPN silicon PLANAR transistors designed specifically for TV-FM receiver applications. hey feature high power gain, low noise and low leakage in a new solid package designed to give maximum echanical support to the transistor chip.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Operating Junction Temperature	125°C Maximum
Storage Temperature	−55°C to +125°C
Soldering Temperature (10 sec time limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Note 2]	0.5 Watt
at 65°C Case Temperature [Note 2]	0.3 Watt
at 25°C Ambient Temperature [Note 2]	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage [Note 3]	12 Volts
V_{EBO}	Emitter to Base Voltage	2.0 Volts

ECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 4]	20	50			$I_C = 8.0$ mA $V_{CE} = 10$ V
V_{CE} (sat)	Collector Saturation Voltage			0.6	Volt	$I_C = 10$ mA $I_B = 1.0$ mA
C_{ob}	Output Capacitance		1.4	1.7	pf	$I_E = 0$ $V_{CB} = 10$ V
C_{ob}	Output Capacitance		2.7	3.0	pf	$I_E = 0$ $V_{CB} = 0$
I_{CBO}	Collector Cutoff Current			0.5	μA	$I_E = 0$ $V_{CB} = 15$ V
I_{CBO} (65°C)	Collector Cutoff Current			5.0	μA	$I_E = 0$ $V_{CB} = 15$ V
h_{fe}	High Frequency Current Gain (f = 100 mc)	6.0	9.0			$I_C = 8.0$ mA $V_{CE} = 10$ V
A_P	Available Power Gain (neutralized) (f = 200 mc)	12	15		db	$I_C = 6.0$ mA $V_{CB} = 10$ V
P_O	Power Output (f = 500 mc)		40		mW	$I_C = 10$ mA $V_{CB} = 10$ V
P_O	Power Output (f = 930 mc) **SE3001**		2.0		mW	$I_C = 10$ mA $V_{CB} = 10$ V
P_O	Power Output (f = 930 mc) **SE3002**	3.0	8.0		mW	$I_C = 10$ mA $V_{CB} = 10$ V
NF	Noise Figure [Note 5]		4.0		db	$I_C = 1.0$ mA $V_{CE} = 6.0$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 3 and 4]	12			Volts	$I_C = 3.0$ mA $I_B = 0$ (pulsed)
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 100$ μA $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	2.0			Volts	$I_C = 0$ $I_E = 100$ μA

OTES:

) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).

3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

4) Pulse Conditions: length ≤ 300 μsec; duty cycle ≤ 2%.

5) f = 60 mc; $R_S = 400\Omega$.

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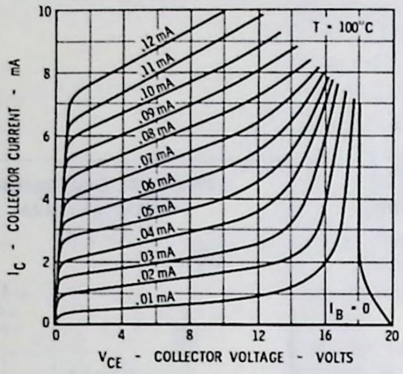
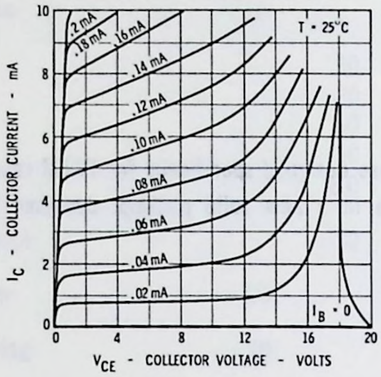
TYPICAL ELECTRICAL CHARACTERISTICS

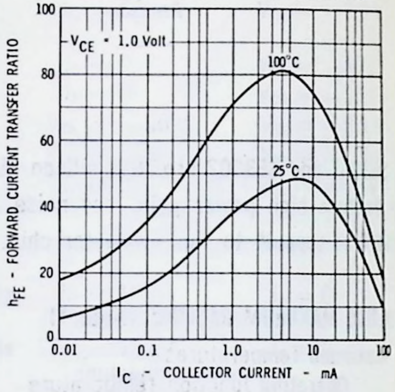
COLLECTOR CHARACTERISTICS



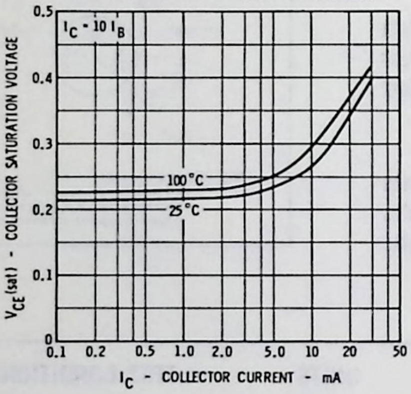
COLLECTOR CHARACTERISTICS



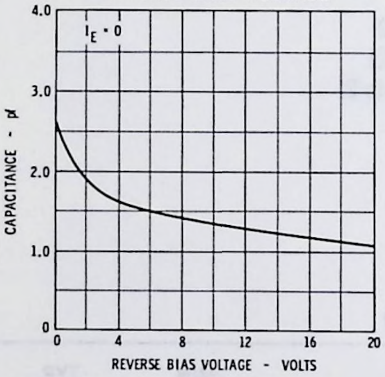
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



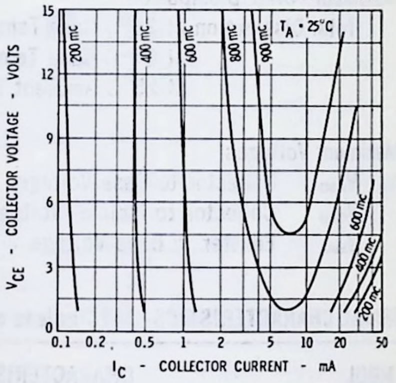
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



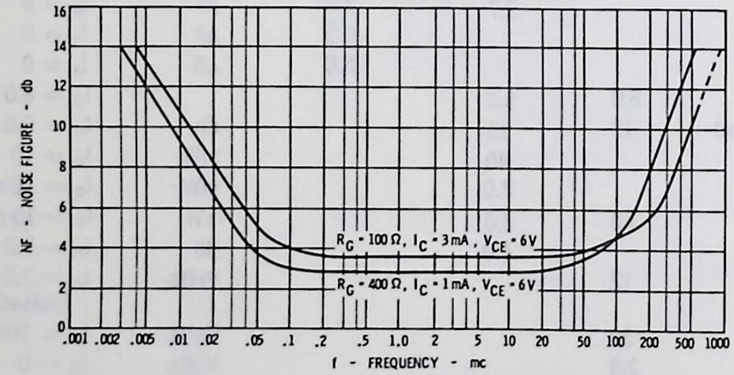
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



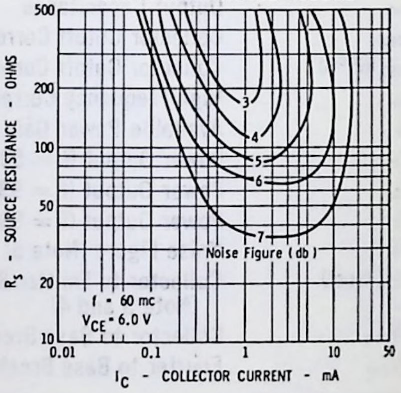
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



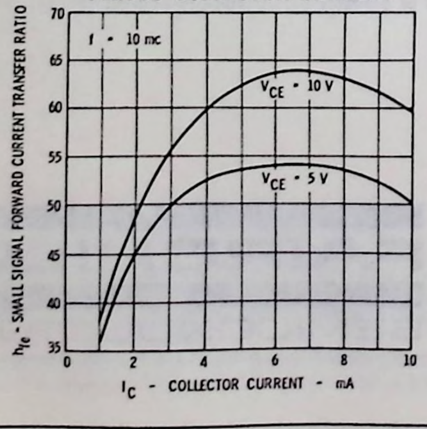
NOISE FIGURE VERSUS FREQUENCY



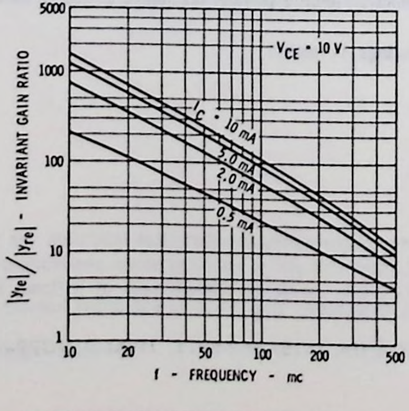
CONTOURS OF CONSTANT NOISE FIGURE



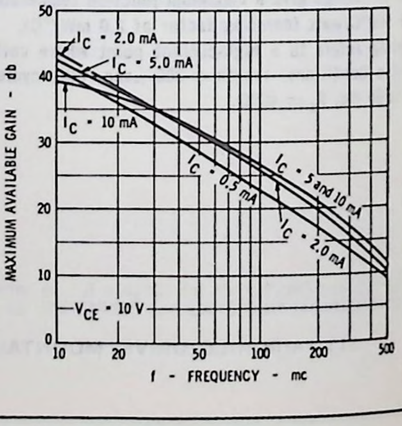
SMALL SIGNAL CURRENT GAIN VERSUS COLLECTOR CURRENT



INVARIANT MAXIMUM STABLE POWER GAIN VERSUS FREQUENCY

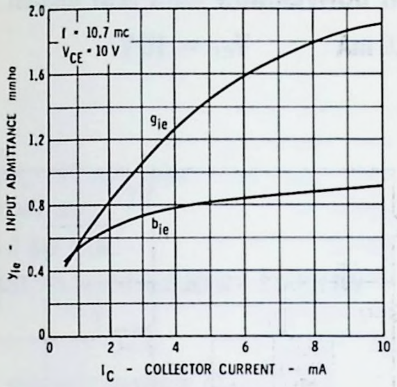


MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY

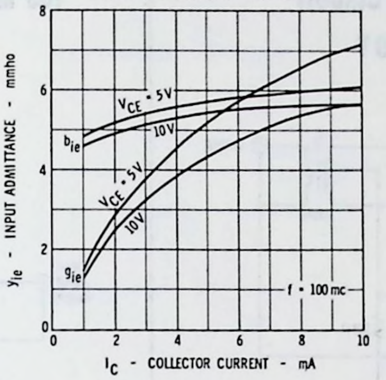


TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

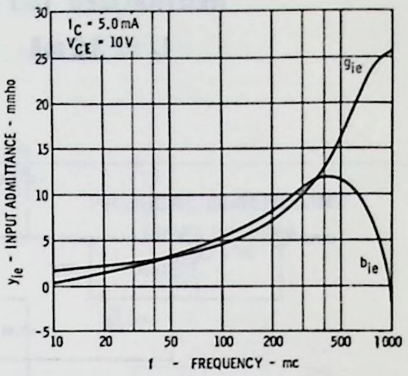
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



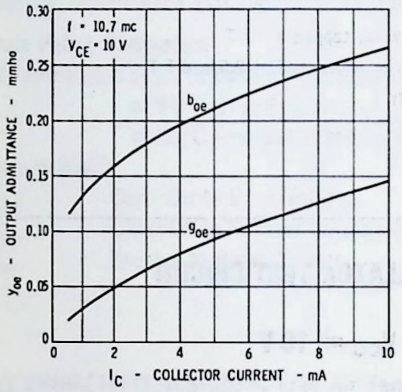
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



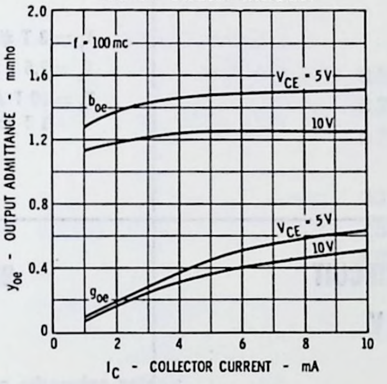
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



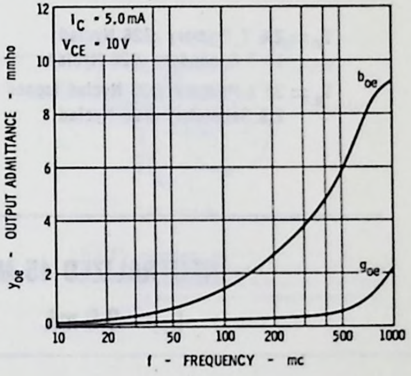
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



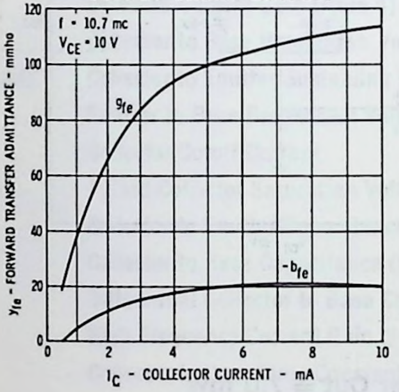
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



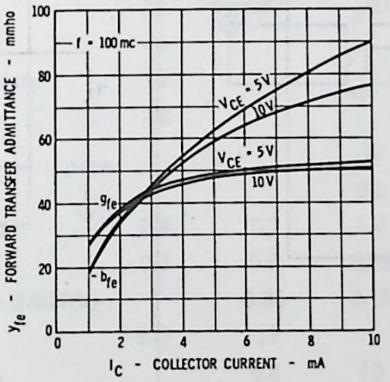
OUTPUT ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



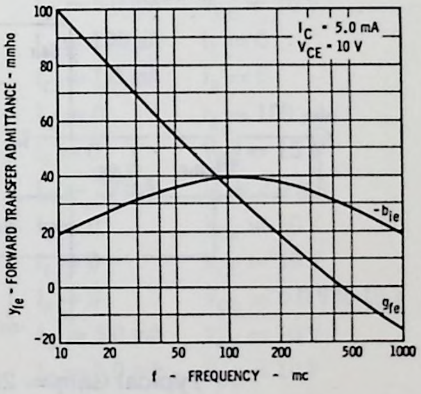
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



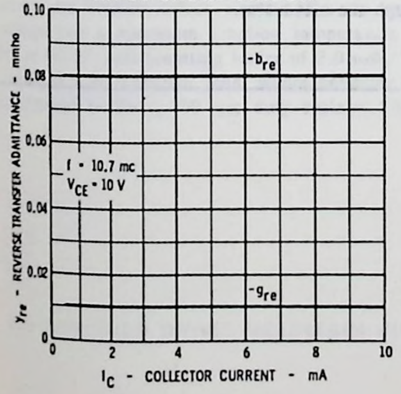
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



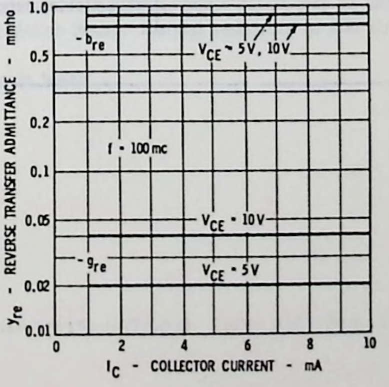
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



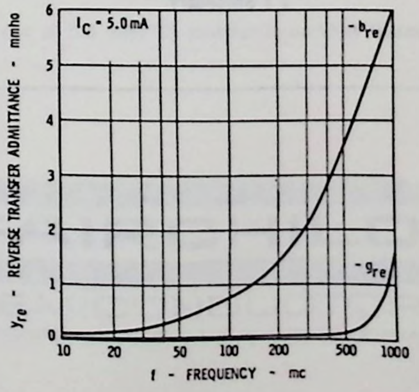
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT

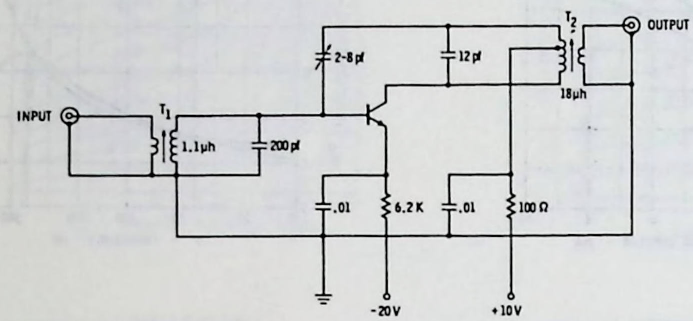


REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



NEUTRALIZED 10.7 MC I.F. TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10$ V


INPUT
T1
1.1µh
200 pf
2-8 pf
12 pf
T2
OUTPUT
18µh
.01
6.2 K
.01
100 Ω
-20V
+10V

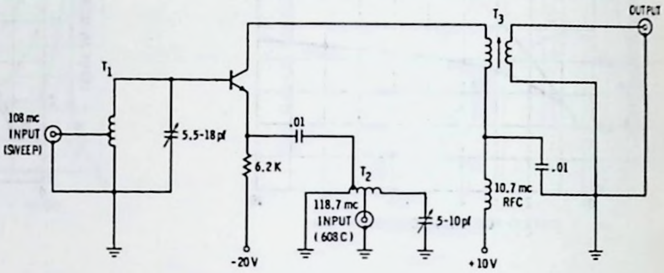
Typical Gain = 37 db

T_1 = 2.6 T Primary #26 Nyclad
10 T Secondary #26 Nyclad

T_2 = 38 T Primary #36 Nyclad tapped at 25 T for Neut.
2.5 Secondary #26 Nyclad

108 MC TO 10.7 MC CONVERSION GAIN TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10$ V


T1
108 mc
INPUT
(SWEEP)
5.5-18 pf
6.2 K
.01
T2
118.7 mc
INPUT
(608 C)
5-10 pf
-20V
T3
OUTPUT
.01
10.7 mc
RFC
+10V

Typical Gain = 25 db

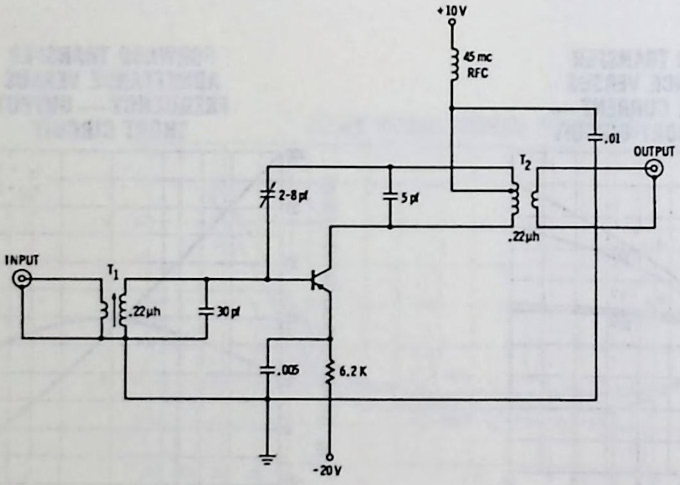
T_1 = 3 T #16 tinned copper wire, tapped at 1 T

T_2 = 2.5 T #16 tinned copper wire, tapped at 0.5 and 1 T

T_3 = 10 T #26 Nyclad Primary
1 T #26 Nyclad Secondary

NEUTRALIZED 45 MC I.F. TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10$ V


+10V
45 mc
RFC
.01
OUTPUT
T2
2-8 pf
5 pf
.22µh
INPUT
T1
.22µh
30 pf
.005
6.2 K
-20V

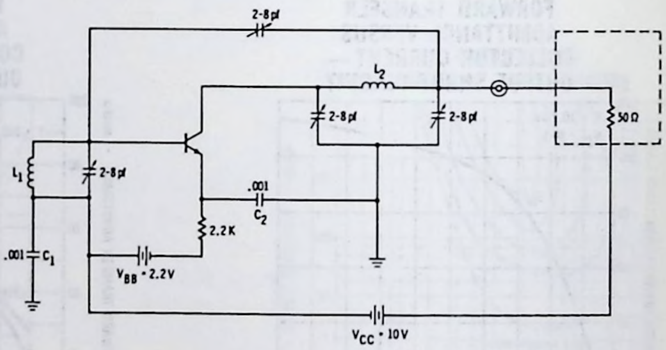
Typical Gain = 28 db

T_1 = 1.2 T Primary #26 Nyclad
4.5 T Secondary #26 Nyclad } Miller #30-106 Core

T_2 = 11 T Primary #26 Nyclad tapped at 4 T for Neut.
1 T Secondary

930 MC OSCILLATOR TEST CIRCUIT

$V_{CC} = 10$ V


2-8 pf
L2
2-8 pf
2-8 pf
50 Ω
L1
2-8 pf
.001
C2
2.2 K
.001
C1
V_BB • 2.2V
V_CC • 10V

Typical Power Out = 7.0 mW

C_1 and C_2 are feed-through capacitors.

L_1 and L_2 are silver tubing with mutual coupling.

This circuit is meant to be used with an attenuator and a filter. The collector supply is fed in through the attenuator.

SE3005

NPN UHF OSCILLATOR

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

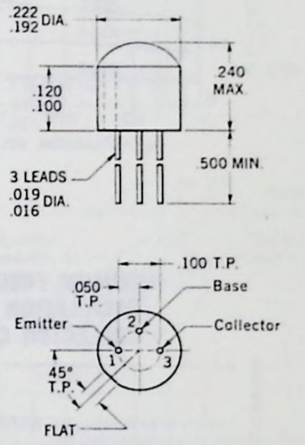
.01 GHz P_o - - 15 mW MIN.

- - - 800 MHz MIN.

- - 1.7 GHz MIN.

XCELLENT VOLTAGE-FREQUENCY STABILITY

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

OLLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Operating Junction Temperature	125°C Maximum
Storage Temperature	−55°C to +125°C
Soldering Temperature (10 second time limit)	

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Note 2)	0.5 Watt
at 65°C Case Temperature (Note 2)	0.3 Watt
at 25°C Ambient Temperature (Note 2)	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
	Power Output (f = 1.0 GHz) (See Fig. 1)	**15**	**25**		**mW**	**$I_C = 8.0$ mA**	**$V_{CC} = 10$ V**
E	DC Pulse Current Gain (Note 4)	45	100	300		$I_C = 5.0$ mA	$V_{CE} = 10$ V
V_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 100\ \mu$A	$I_E = 0$
$_{CEO}$(sust)	Collector to Emitter Sustaining Voltage (Note 3)	15			Volts	$I_C = 1.0$ mA	$I_B = 0$
V_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	$I_C = 0$	$I_E = 100\ \mu$A
$_{CBO}$	Collector Cutoff Current			10	nA	$I_E = 0$	$V_{CB} = 15$ V
$_{CE}$(sat)	Pulsed Collector Saturation Voltage			0.1	Volt	$I_C = 20$ mA	$I_B = 2.0$ mA
e	Collector to Emitter Capacitance (f = 1.0 MHz)	0.3	0.7	1.0	pF	$I_E = 0$	$V_{CE} = 10$ V
b	Collector to Base Capacitance (f = 1.0 MHz)	0.3	0.6	0.85	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{cb}	**Differential Collector to Base Capacitance (f = 1.0 MHz)**		**0.08**	**0.15**	**pF**	**$I_E = 0$**	**$V_{CB} = 5.0$ V to 10 V**
e	**High Frequency Current Gain (f = 100 MHz)**	**8.0**	**12**			**$I_C = 5.0$ mA**	**$V_{CE} = 10$ V**
C_c	Collector to Base Time Constant (f = 80 MHz)		6.0	10	ps	$I_C = 5.0$ mA	$V_{CE} = 10$ V
ax :	**Maximum Frequency of Oscillation**	**1.7**	**2.8**		**GHz**	**$I_C = 5.0$ mA**	**$V_{CE} = 10$ V**

*Planar is a patented Fairchild process.

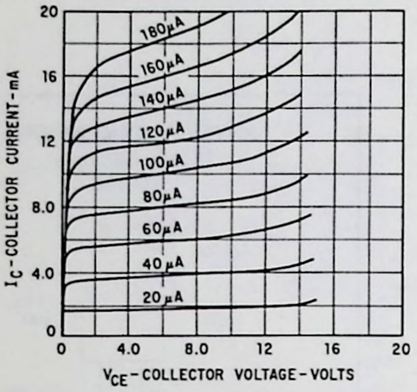
:

ese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
ese ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C) junction-to-ambient thermal istance of 500°C/watt (derating factor of 2.0 mW/°C).
ting refers to a high current point where collector to emitter voltage is lowest.
se Conditions: length ≤ 300 μs; duty cycle ≤ 2%.

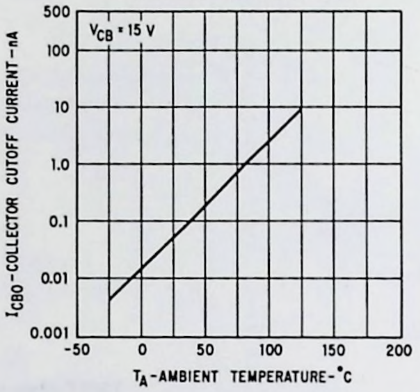
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

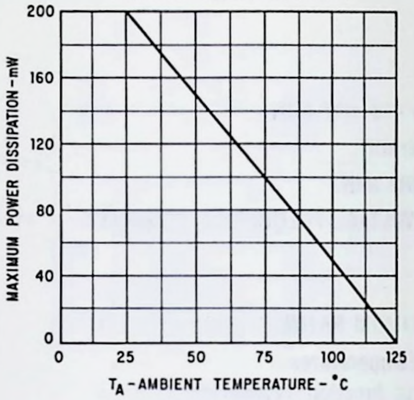
COLLECTOR CHARACTERISTICS



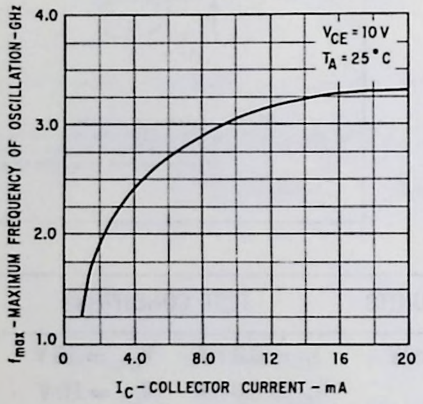
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



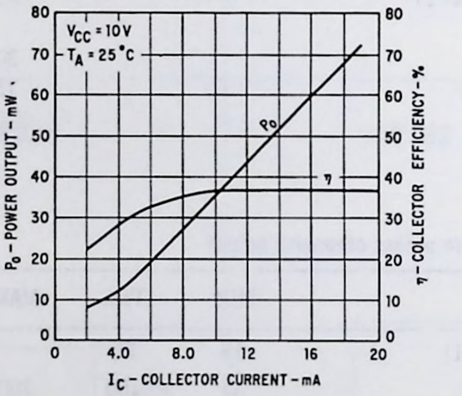
MAXIMUM POWER DISSIPATION VERSUS TEMPERATURE



MAXIMUM FREQUENCY OF OSCILLATION VERSUS COLLECTOR CURRENT



POWER OUTPUT AND COLLECTOR EFFICIENCY VERSUS COLLECTOR CURRENT IN STUB OSCILLATOR CIRCUIT



POWER OUTPUT VERSUS FREQUENCY IN STUB OSCILLATOR CIRCUIT

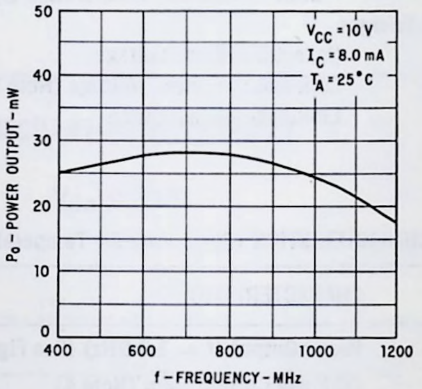
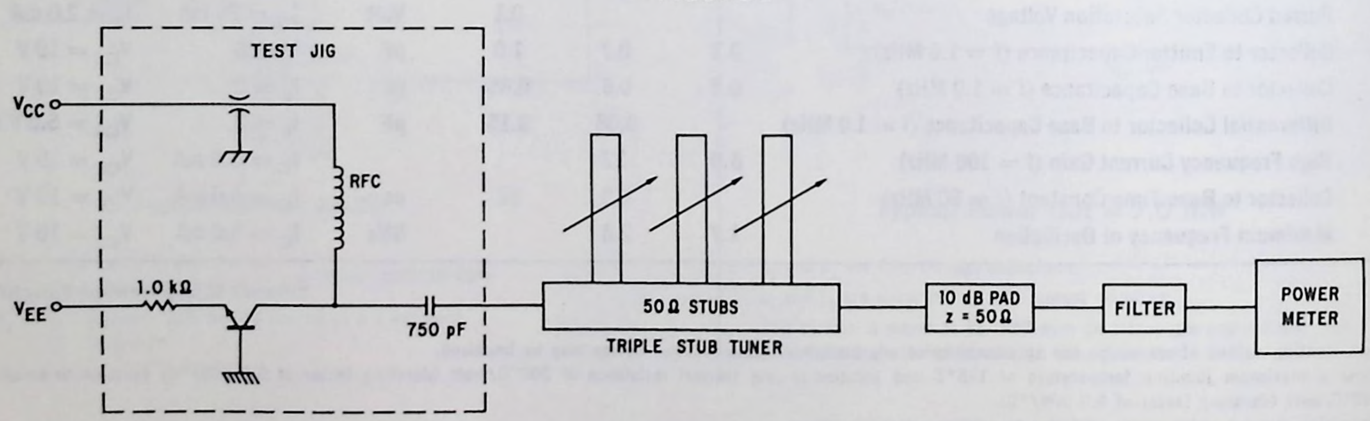


FIGURE 1


TEST JIG
V_{CC}
V_{EE}
RFC
1.0 kΩ
750 pF
50 Ω STUBS
TRIPLE STUB TUNER
10 dB PAD
z = 50 Ω
FILTER
POWER METER

EQUIPMENT:

(1) Test Jig
(2) Triple Stub Tuner (Empire Model ST-33 A)
(3) 10 dB Pad (Narda Model 766-10)
(4) Filter (Telonic Model TTF-1000-5-5 EE)
(5) Power Meter (General Microwave Model 454 A)

TEST PROCEDURE:

(1) Apply Vcc and VEE
(2) Set Filter to 1.0 GHz
(3) Tune Stubs for Max. Power Out.

EN3009 • EN3013 • EN3014

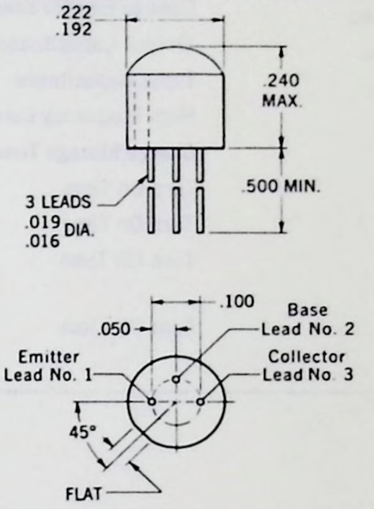
NPN HIGH SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N3009, 2N3013 AND 2N3014 DATA SHEETS

- **ELECTRICAL REPLACEMENTS FOR 2N3009, 2N3013 AND 2N3014**
- **HIGH SPEED - - $\tau_s = 18$ns (max.) at 10 mA**
- **LOW SATURATION VOLTAGE - - $V_{CE}(sat) = 0.18$ V (max.) at 30 mA**
  - - $V_{CE}(sat) = 0.25$ V (max.) at 30 mA and +100°C
  - - $V_{CE}(sat) = 0.5$ V (max.) at 300 mA

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +125°C
Operating Junction Temperature	125°C Maximum
Lead Temperature (Soldering, 10 Second Time Limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages

		EN3009	EN3013	EN3014
V_{CBO}	Collector to Base Voltage	40	40	40 Volts
V_{CES}	Collector to Emitter Voltage	40	40	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15	15	20 Volts
V_{EBO}	Emitter to Base Voltage	4.0	5.0	5.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	EN3009 MIN.	EN3009 MAX.	EN3013 MIN.	EN3013 MAX.	EN3014 MIN.	EN3014 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)					25			$I_C = 10$ mA	$V_{CE} = 0.4$V
h_{FE}	DC Pulse Current Gain (Note 5)	30	120	30	120	30	120		$I_C = 30$ mA	$V_{CE} = 0.4$V
h_{FE} (−55°C)	DC Pulse Current Gain (Note 5)			12		12			$I_C = 30$ mA	$V_{CE} = 0.4$V
h_{FE}	DC Pulse Current Gain (Note 5)	25		25					$I_C = 100$ mA	$V_{CE} = 0.5$V
h_{FE}	DC Pulse Current Gain (Note 5)					25			$I_C = 100$ mA	$V_{CE} = 1.0$V
h_{FE}	DC Pulse Current Gain (Note 5)	15		15					$I_C = 300$ mA	$V_{CE} = 1.0$V
V_{CE}(sat)	Collector Saturation Voltage						0.18	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	**Collector Saturation Voltage**		**0.18**		**0.18**		**0.18**	**Volts**	**$I_C = 30$ mA**	**$I_B = 3.0$ mA**
V_{CE}(sat) (+85°)	Collector Saturation Voltage		0.30					Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE}(sat) (+100°C)	**Collector Saturation Voltage**				**0.25**		**0.25**	**Volts**	**$I_C = 30$ mA**	**$I_B = 3.0$ mA**
V_{CE}(sat)	Collector Saturation Voltage		0.28		0.28		0.35	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{CE}(sat)	**Collector Saturation Voltage**		**0.50**		**0.50**			**Volts**	**$I_C = 300$ mA**	**$I_B = 30$ mA**
V_{BE}(sat)	Base Saturation Voltage					0.70	0.80	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage	0.75	0.95	0.75	0.95	0.75	0.95	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE}(sat)	Base Saturation Voltage		1.20		1.20		1.20	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE}(sat)	Base Saturation Voltage		1.70		1.70			Volts	$I_C = 300$ mA	$I_B = 30$ mA
I_{CES}	Collector Cutoff Current		0.50		0.30		0.30	µA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CES} (+85°C)	Collector Cutoff Current		15					µA	$V_{CE} = 20$ V	$V_{BE} = 0$

*Planar is a patented Fairchild process.

FAIRCHILD
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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	EN3009 MIN.	EN3009 MAX.	EN3013 MIN.	EN3013 MAX.	EN3014 MIN.	EN3014 MAX.	UNITS	TEST CONDITIONS	
I_{CES} (+100°C)	Collector Cutoff Current				20		20	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40		40		40		Volts	$I_C = 100\ \mu$A	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	40		40		40		Volts	$I_C = 100\ \mu$A	$V_{BE} = 0$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	15		15		20		Volts	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Base to Emitter Breakdown Voltage	4.0		5.0		5.0		Volts	$I_C = 0$	$I_E = 100\ \mu$A
C_{obo}	Output Capacitance		5.0		5.0		5.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{ibo}	Input Capacitance		8.0		8.0		8.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.5		3.5		3.5			$I_C = 30$ mA	$V_{CE} = 10$ V
τ_S	**Charge Storage Time Constant**		**18**		**18**		**18**	**ns**	$I_C \approx I_{B1} \approx -I_{B2} \approx 10$ mA	
t_{on}	Turn On Time		15		15			ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{on}	Turn On Time						16	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	Turn Off Time						25	ns	$I_C \approx 30$ mA $I_{B2} \approx -3.0$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	Turn Off Time		25		25			ns	$I_C \approx 300$ mA $I_{B2} \approx -30$ mA	$I_{B1} \approx 30$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C). Junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

EN3250

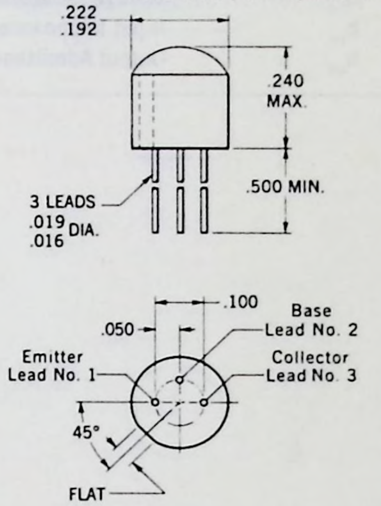
PNP HIGH SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTOR

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N3250 DATA SHEET

- **ELECTRICAL REPLACEMENT FOR 2N3250**
- **HIGH FREQUENCY - - f_T = 250 MHz (min) at 10mA**
- **LOW NOISE - - NF = 6 dB (max) at 100Hz**
- **HIGH BREAKDOWN - - BV_{CEO} = 40 V (min) at 10mA**
- **LOW CAPACITANCE - - C_{obo} = 6.0 pF (max)**

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−55°C to +125°C
Operating Junction Temperature		+125°C
Soldering Temperature (10 seconds time limit)		+260°C
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperatures (Notes 2 and 3)		0.5 Watt
at 25°C Free Air Temperature (Notes 2 and 3)		0.2 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	−40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	40			$I_C = 100\ \mu A$	$V_{CE} = -1.0$ V
h_{FE}	DC Current Gain	45			$I_C = 1.0$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	50	150		$I_C = 10$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	15			$I_C = 50$ mA	$V_{CE} = -1.0$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**2.5**			**$I_C = 10$ mA**	**$V_{CE} = -20$ V**
$V_{CE}(sat)$	Collector Saturation Voltage (Note 5)		−0.25	Volt	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE}(sat)$	Collector Saturation Voltage (Note 5)		−0.5	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage (Note 5)	−0.6	−0.9	Volt	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage (Note 5)		−1.2	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
BV_{CEO}	**Collector to Emitter Breakdown Voltage** (Notes 4 and 5)	**−40**		**Volts**	**$I_C = 10$ mA**	**$I_B = 0$**
BV_{CBO}	Collector to Base Breakdown Voltage	−50		Volts	$I_C = 10\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		Volts	$I_C = 0$	$I_E = 10\ \mu A$
C_{obo}	**Output Capacitance**		**6.0**	**pF**	**$I_E = 0$**	**$V_{CB} = -10$ V**
C_{TE}	Emitter Transition Capacitance		8.0	pF	$I_C = 0$	$V_{EB} = -1.0$ V
t_d	Delay Time		35	ns	$I_C = 10$ mA	$I_{B1} = 1.0$ mA
t_r	Rise Time		35	ns	$I_C = 10$ mA	$I_{B1} = 1.0$ mA
t_s	Storage Time		175	ns	$I_C = 10$ mA	$I_{B1} = I_{B2} = 1.0$ mA
t_f	Fall Time		50	ns	$I_C = 10$ mA	$I_{B1} = I_{B2} = 1.0$ mA

*Planar is a patented Fairchild process.

FAIRCHILD TRANSISTOR EN3250

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
$r_b{}'C_c$	Collector Base Time Constant (f = 31.8 MHz)		250	ps	$I_C = 10$ mA	$V_{CE} = -20$ V
NF	**Noise Figure (f = 100 Hz)**		**6.0**	**dB**	$I_C = 100\ \mu A$	$V_{CE} = -5.0$ V
I_{CEX}	Collector Current		50	nA	$V_{CE} = -40$ V	$V_{EB} = -3.0$ V
I_{BL}	Base Current		100	nA	$V_{CE} = -40$ V	$V_{EB} = -3.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50	200		$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)		10	$x10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{ie}	Input Impedance (f = 1.0 kHz)	1.0	6.0	kΩ	$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{oe}	Output Admittance (f = 1.0 kHz)	4.0	40	μmho	$I_C = 1.0$ mA	$V_{CE} = -10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0mW/°C).
(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

EN3502 · EN3504

PNP HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTORS

FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N3502 DATA SHEET

ELECTRICAL REPLACEMENTS FOR 2N3502 AND 2N3504

HIGH BETA - - $h_{FE} = 80$ (MIN) AT 10 μA

- - $h_{FE} = 100\text{-}300$ AT 150 mA

- - $h_{FE} = 30$ (MIN) AT 500 mA

LOW SATURATION VOLTAGE - - $V_{CE(sat)} = 0.4$ V (MAX) AT 150 mA

FAST SWITCHING - - $t_{off} = 100$ ns (MAX) AT 300 mA

HIGH BREAKDOWN VOLTAGE - - $LV_{CEO} = 45$ V (MIN)

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 sec time limit)	+260°C Maximum

Maximum Power Dissipation (Notes 2 & 3)	**EN3502**	**EN3504**
Total Dissipation at 25°C Case Temperature	0.7 Watt	0.5 Watt
at 25°C Free Air Temperature	0.3 Watt	0.2 Watt

Maximum Voltages and Current

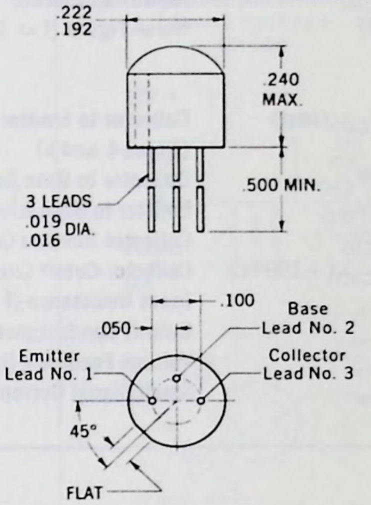
V_{CBO}	Collector to Base Voltage	−45 Volts	−45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−45 Volts	−45 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C	Collector Current (Note 2)	600 mA	600 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	**80**			**$I_C = 10\ \mu A$**	**$V_{CE} = -10$ V**
h_{FE}	DC Current Gain	120			$I_C = 100\ \mu A$	$V_{CE} = -10$ V
h_{FE}	DC Current Gain	135			$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	140			$I_C = 10$ mA	$V_{CE} = -10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	115	300		$I_C = 50$ mA	$V_{CE} = -1.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**100**	**300**		**$I_C = 150$ mA**	**$V_{CE} = -10$ V**
h_{FE}	**DC Pulse Current Gain** (Note 5)	**30**			**$I_C = 500$ mA**	**$V_{CE} = -10$ V**
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	50			$I_C = 50$ mA	$V_{CE} = -10$ V
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, see Note 5)		−0.25	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{CE}(sat)	**Collector Saturation Voltage** (Pulsed, see Note 5)		**−0.4**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, see Note 5)		−1.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{BE}(sat)	Base Saturation Voltage (Pulsed, see Note 5)		−1.0	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{BE}(sat)	Base Saturation Voltage (Pulsed, see Note 5)		−1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline

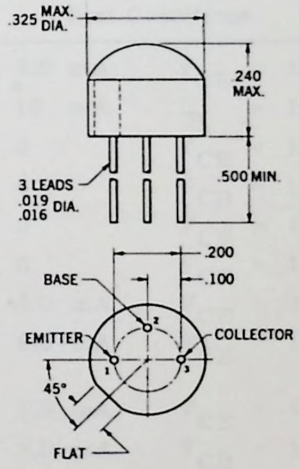


NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

EN3504

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-105) outline



NOTES All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

EN3502

*Planar is a patented Fairchild process.

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
V_{BE}(sat)	Base-Emitter Voltage (Pulsed, see Note 5)		−2.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
h_{FE}	High Frequency Current Gain (f = 100 MHz)	1.5			$I_C = 50$ mA	$V_{CE} = -3.0$ V
t_{on}	Turn On Time		40	ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	**Turn Off Time**		**100**	**ns**	**$I_C \approx 300$ mA**	**$I_{B1} \approx 30$ mA,** **$I_{B2} \approx -30$ mA**
C_{obo}	Output Capacitance		8.0	pF	$I_E = 0$	$V_{CB} = -10$ V
C_{ibo}	Input Capacitance		25	pF	$I_C = 0$	$V_{EB} = -0.5$ V
NF	Noise Figure (f = 1.0 kHz)		4.0	dB	$I_C = 30\ \mu A$	$V_{CE} = 15.0$ V, PB = 200 Hz, $R_S = 10\ k\Omega$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	−45		**Volts**	**$I_C = 10$ mA** (pulsed)	**$I_B = 0$**
BV_{CBO}	Collector to Base Breakdown Voltage	−45		Volts	$I_C = 10\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		Volts	$I_E = 10\ \mu A$	$I_C = 0$
I_{CES}	Collector Reverse Current		10	nA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CBO}(+100°C)	Collector Cutoff Current		10	μA	$V_{CB} = -30$ V	$I_E = 0$
h_{ie}	Input Resistance (f = 1.0 kHz)		2300	Ω	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{oe}	Output Conductance (f = 1.0 kHz)		1200	μmhos	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)		1500	$\times 10^{-6}$	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	135	420		$I_C = 10$ mA	$V_{CE} = -10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/Watt (derating factor of 7.0 mW/°C) for the EN3502 and 200°C/Watt (derating factor of 5.0 mW/°C) for the EN3504. Junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C) for the EN3502 and 500°C/Watt (derating factor of 2.0 mW/°C) for the EN3504.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

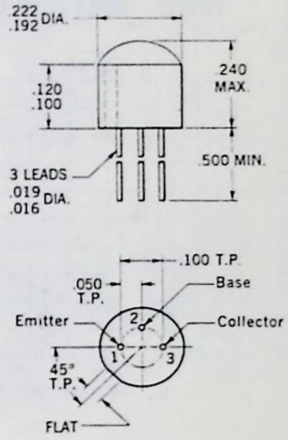
2N3563

NPN LOW LEVEL RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

The 2N3563 is an NPN silicon PLANAR epitaxial transistor designed for low-level RF applications. It features high power gain, low noise and low leakage in a new solid package designed to give maximum mechanical support to the transistor chip.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Operating Junction Temperature		+125°C Maximum
Storage Temperature		-55°C to +125°C
Soldering Temperature (10 sec. time limit)		+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Note 2)	0.5 Watt
at 65°C Case Temperature	(Note 2)	0.3 Watt
at 25°C Ambient Temperature	(Note 2)	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		30 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 3)	12 Volts
V_{EBO}	Emitter to Base Voltage		2.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics		Min.	Typ.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain	(Note 4)	20	50	200		I_C = 8.0 mA	V_{CE} = 10 V
V_{CE}(sat)	Collector Saturation Voltage			0.1		Volts	I_C = 10 mA	I_B = 1.0 mA
C_{obo}	Open Circuit Output Capacitance			1.3	1.7	pf	I_E = 0	V_{CB} = 10 V
C_{cb}	Collector-base Transfer	(Note 7)		0.8		pf	I_E = 0	V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current				50	nA	I_E = 0	V_{CB} = 15 V
I_{CBO}(65°C)	Collector Cutoff Current				5.0	µA	I_E = 0	V_{CB} = 15 V
h_{fe}	High Frequency Current Gain (f = 100 mc)		6.0	9.0			I_C = 8.0 mA	V_{CE} = 10 V
G_{pe}	Available Power Gain (neutralized) (f = 200 mc)	(Note 5)	14	17		db	I_C = 8.0 mA	V_{CE} = 10 V
NF	Noise Figure	(Note 6)		4.0		db	I_C = 1.0 mA	V_{CE} = 6.0 V
$r_b'C_c$	Collector-Base Time Constant (f = 79.8 mc)		8.0	15	25	psec	I_C = 8.0 mA	V_{CB} = 10 V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)		20		250		I_C = 8.0 mA	V_{CE} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage		30			Volts	I_E = 0	I_C = 100 µA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 3 and 4)		12			Volts	I_C = 3.0 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage		2.0			Volts	I_C = 0	I_E = 10 µA

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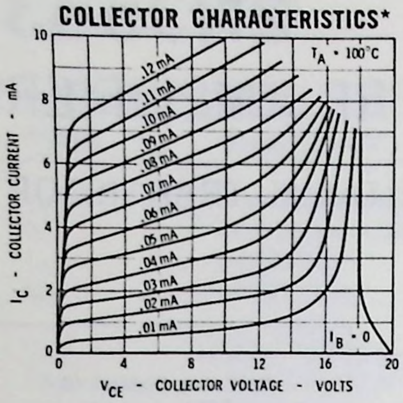
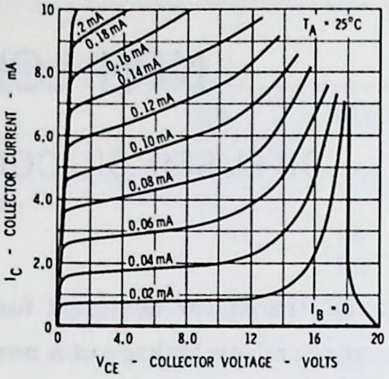
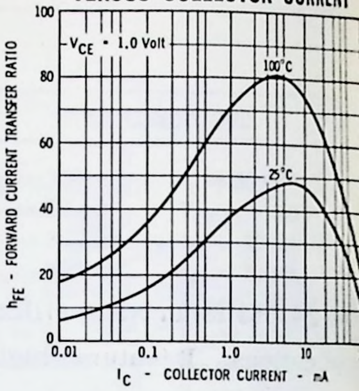
COLLECTOR CHARACTERISTICS*



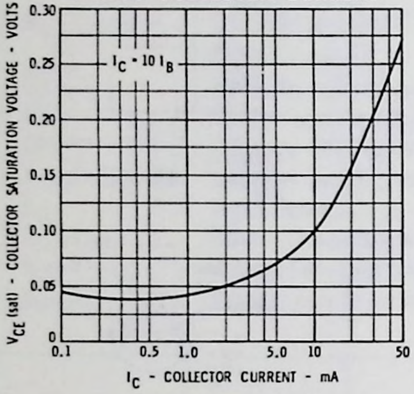
COLLECTOR CHARACTERISTICS*



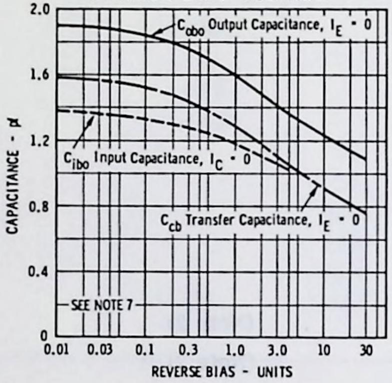
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



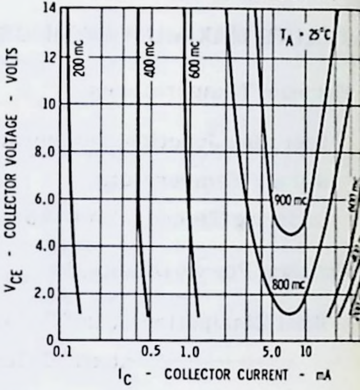
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



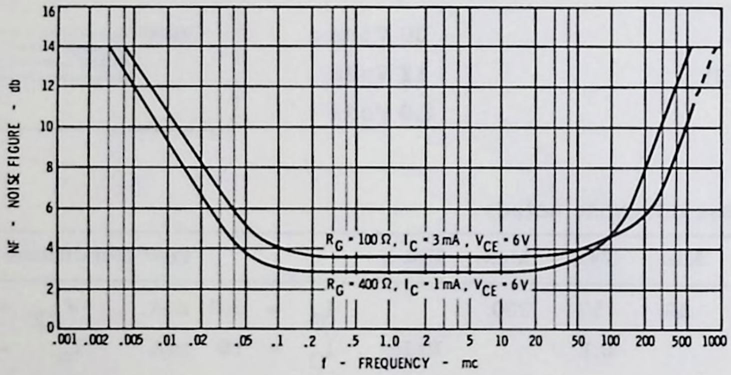
CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



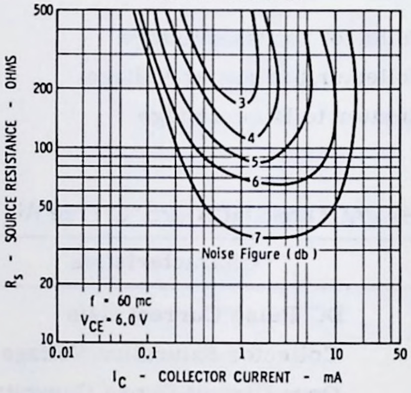
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



NOISE FIGURE VERSUS FREQUENCY

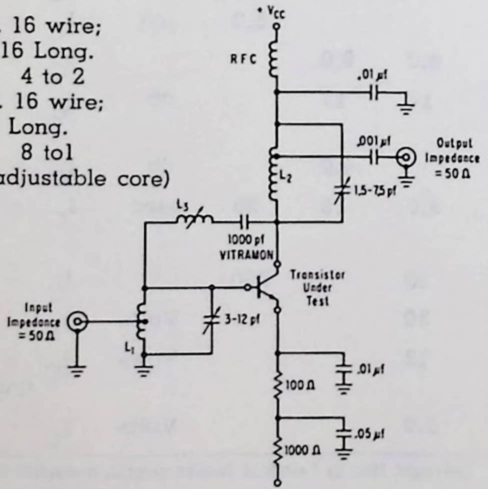


CONTOURS OF CONSTANT NOISE FIGURE



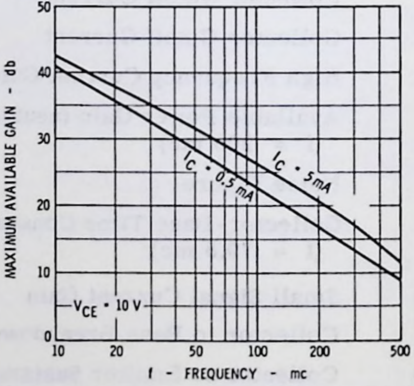
NEUTRALIZED 200 MC POWER GAIN AMPLIFIER TEST CIRCUIT

L_1 — 3.5 Turns No. 16 wire;
5/16 Dia; 7/16 Long.
Turns Ratio 4 to 2
L_2 — 8.0 Turns No. 16 wire;
1/8 Dia; 7/8 Long.
Turns Ratio 8 to1
L_3 — 0.4-0.65 μh (adjustable core)



+ V_{CC}
RFC
.01 μf
.001 μf
Output Impedance = 50 Ω
L_2
1.5-7.5 pf
L_3
1000 pf VITRAMON
Transistor Under Test
Input Impedance = 50 Ω
L_1
3-12 pf
.01 μf
100 Ω
.05 μf
1000 Ω
- V_{EE}

MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY



* Single family characteristics on Transistor Curve Tr

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junct ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μsec; duty cycle ≤ 1%.

(5) Forward gain (db) + reverse gain (db) $<$ (-20 db). See test circuit.

(6) f = 60 mc; R_S = 400 Ω.

(7) C_{cb} is measured using a three-terminal measurement technique with case and emitter guarded. C_{cb} is equivalent to C_{re}.

2N3564

NPN RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

NERAL DESCRIPTION - The 2N3564 is an NPN silicon PLANAR Epitaxial Transistor. It is igned for high-frequency wide-band amplifiers and is useful in low-power, small-signal tuned and IF applications. This device is similar to the SE 1010.

SOLUTE MAXIMUM RATINGS [Note 1]

aximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 sec. time limit)	+260°C Maximum

aximum Power Dissipation

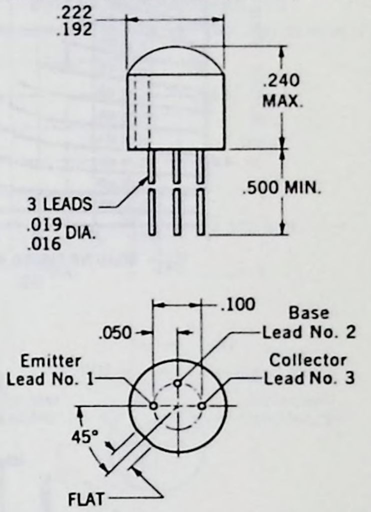
Total Dissipation at 25°C Case Temperature	(Note 2)	0.5 Watt
at 65°C Case Temperature	(Note 2)	0.3 Watt
at 25°C Ambient Temperature	(Note 2)	0.2 Watt

aximum Voltages

V_{CBO}	Collector to Base Voltage		30 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 3)	15 Volts
V_{EBO}	Emitter to Base Voltage		4.0 Volts

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristics		Min.	Typ.	Max.	Units	Test Conditions							
BV_{CBO}	Collector to Base Breakdown Voltage		30			Volts	I_C	=	100	μA	I_E	=	0	
BV_{EBO}	Emitter to Base Breakdown Voltage		4.0			Volts	I_E	=	100	μA	I_C	=	0	
$BV_{CEO}(sust)$	Collector to Emitter Sustaining Voltage	(Notes 3 & 4)	15			Volts	I_C	=	10	mA	I_B	=	0	
$V_{CE}(sat)$	Collector Saturation Voltage				0.3	Volts	I_C	=	20	mA	I_B	=	2.0	mA
$V_{BE}(sat)$	Base Saturation Voltage				0.97	Volts	I_C	=	20	mA	I_B	=	2.0	mA
I_{CBO}	Collector Cutoff Current				50	nA	V_{CB}	=	15	V	I_E	=	0	
h_{FE}	DC Pulse Current Gain	(Note 4)	20	70			I_C	=	15	mA	V_{CE}	=	10	V
h_{fe}	Low Frequency Current Gain (f = 1 kHz)		20	80			I_C	=	15	mA	V_{CE}	=	10	V
h_{fe}	High Frequency Current Gain (f = 100 MHz)		4.0	7.5			I_C	=	15	mA	V_{CE}	=	10	V
r_b	Real Part of h_{ie} (f = 350 MHz)			30		ohms	I_C	=	15	mA	V_{CE}	=	10	V
C_{obo}	Open Circuit Output Capacitance			2.5	3.5	pF	V_{CB}	=	10	V	I_E	=	0	

*Planar is a patented Fairchild process.

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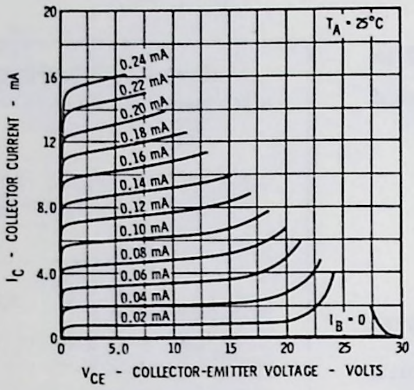
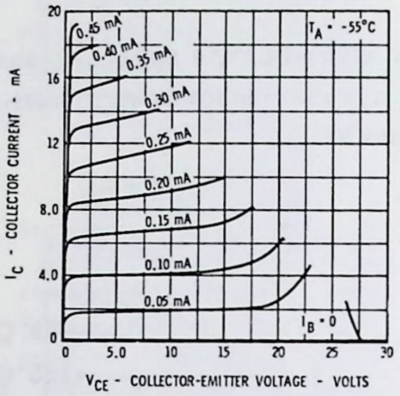
TYPICAL ELECTRICAL CHARACTERISTICS

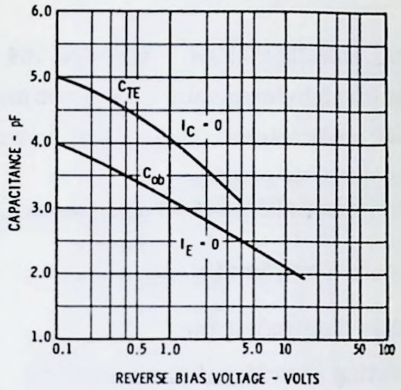
COLLECTOR CHARACTERISTICS*



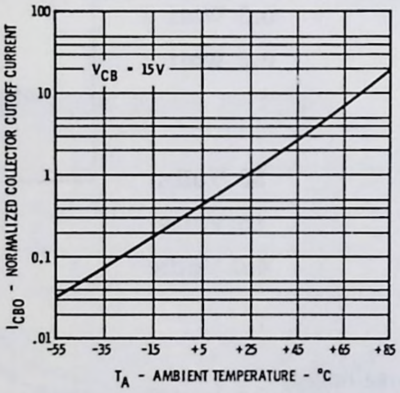
COLLECTOR CHARACTERISTICS*



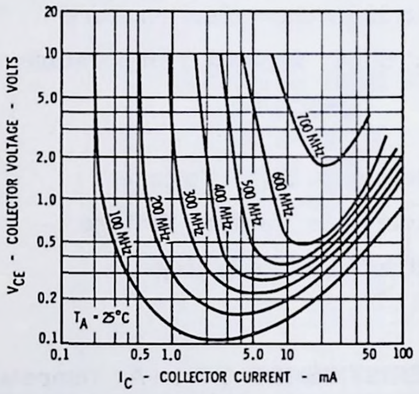
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



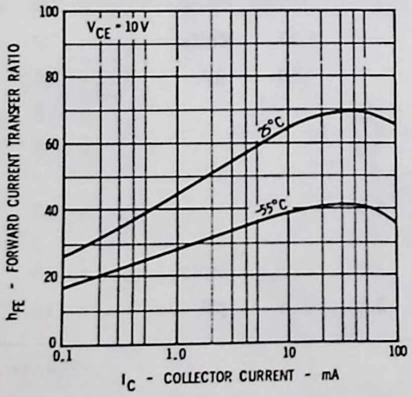
NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



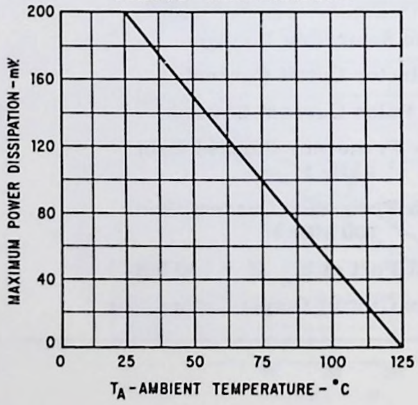
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



MAXIMUM POWER DISSIPATION VERSUS TEMPERATURE



* Single family characteristics on Transistor Curve Tracer

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-to- ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μs ; duty cycle ≤ 1%.

2N3565

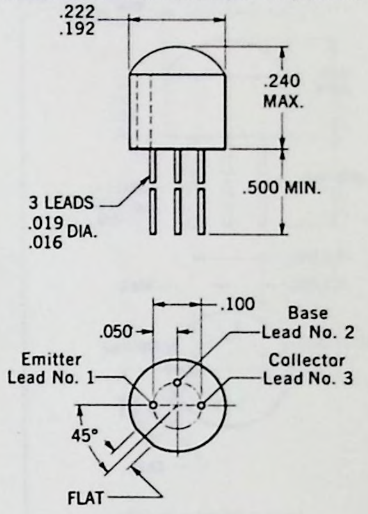
NPN HIGH GAIN

DIFFUSED SILICON PLANAR*TRANSISTOR

e 2N3565 is a very high beta NPN silicon PLANAR* transistor suited for high gain audio pre-plifier stages and direct coupled circuits. It also features the solid package designed to give ximum mechanical support to the transistor chip. This is similar to the SE 4002.

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

* Planar is a patented Fairchild process.

OLUTE MAXIMUM RATINGS [Note 1]

ximum Temperatures

Operating Junction Temperature	+125°C Maximum
Storage Temperature	-55°C to +125°C
Soldering Temperature (10 sec. time limit)	+260°C Maximum

ximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Note 2)	0.5 Watt
at 65°C Case Temperature	(Note 2)	0.3 Watt
at 25°C Ambient Temperature	(Note 2)	0.2 Watt

ximum Voltages

V_{CBO}	Collector to Base Voltage		30 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 3)	25 Volts
V_{EBO}	Emitter to Base Voltage		6.0 Volts

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

bol	Characteristic	Min.	Max.	Units	Test Conditions	
E	DC Current Gain	150	600		I_C = 1.0 mA	V_{CE} = 10 V
E	DC Current Gain	70			I_C = 100 μA	V_{CE} = 10 V
	High Frequency Current Gain (f = 20 MHz)	2.0			I_C = 1.0 mA	V_{CE} = 5.0 V
E(sat)	Collector Saturation Voltage		0.35	Volts	I_C = 1.0 mA	I_B = 0.1 mA
O	Collector Cutoff Current		50	nA	I_E = 0	V_{CB} = 25 V
O(65°C)	Collector Cutoff Current		3.0	μA	I_E = 0	V_{CB} = 25 V
o	Open Circuit Output Capacitance		4.0	pF	I_E = 0	V_{CB} = 5.0 V
CBO	Collector to Base Breakdown Voltage	30		Volts	I_E = 0	I_C = 100 μA
EO(sust)	Collector to Emitter Sustaining Voltage (Note 3)	25		Volts	I_B = 0	I_C = 2.0 mA
EBO	Emitter to Base Breakdown Voltage	6.0		Volts	I_C = 0	I_E = 10 μA

ES:

ese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

ese ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

ing refers to a high-current point where collector-to-emitter voltage is lowest.

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FAIRCHILD TRANSISTOR 2N3565

SMALL SIGNAL CHARACTERISTICS (f=1kHz, TA=25°C)

Symbol	Characteristic	Min.	Typ.	Max.	Units		
h_{ie}	Input Resistance	2.0	7.5	20	kohms	I_C = 1.0 mA	V_{CE} = 5.0
h_{oe}	Output Conductance		11	35	μmhos	I_C = 1.0 mA	V_{CE} = 5.0
h_{re}	Voltage Feedback Ratio		300		$x10^{-6}$	I_C = 1.0 mA	V_{CE} = 5.0
h_{fe}	Small Signal Current Gain	120	280	750		I_C = 1.0 mA	V_{CE} = 5.0
h_{ib}	Input Resistance		27		Ohms	I_C = 1.0 mA	V_{CB} = 5.0

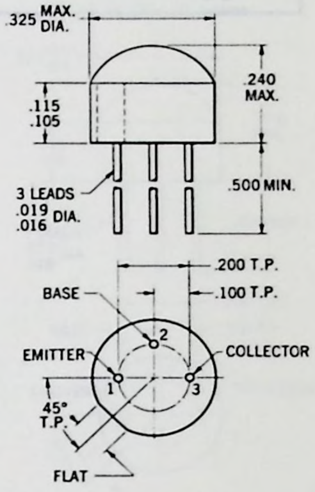
2N3566

NPN HIGH GAIN TYPE

DIFFUSED SILICON PLANAR TRANSISTOR

ENERAL DESCRIPTION - The 2N3566 is an NPN Silicon Planar Transistor designed for use n applications requiring very high gain. It is suitable for medium power output driver and low ower output circuits. This device is encased in a solid package designed to give maximum echanical support to the transistor chip. This device is similar to the SE 6002.

PHYSICAL DIMENSIONS
Epoxy package
TO-105



NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non conductive material
Package weight is 0.66 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 sec. time limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.8 Watt
at 75°C Case Temperature	(Notes 2 and 3)	0.4 Watt
at 25°C Ambient Temperature	(Notes 2 and 3)	0.3 Watt

Maximum Voltage

V_{CBO}	Collector to Base Voltage		40 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage		5.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	150	400	600		I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	80	325			I_C = 2.0 mA V_{CE} = 10 V
V_{BE}	Base-Emitter Voltage (pulsed, see Note 5)		0.87	0.9	Volts	I_C = 100 mA V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage (pulsed, see Note 5)		0.9	1.0	Volts	I_C = 100 mA I_B = 10 mA
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.0				I_C = 30 mA V_{CE} = 10 V
C_{obo}	Open Circuit Output Capacitance		13	25	pf	I_E = 0 V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current			50	nA	I_E = 0 V_{CB} = 20 V
I_{CBO}(75°C)	Collector Cutoff Current			5.0	μA	I_E = 0 V_{CB} = 20 V
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	I_E = 0 I_C = 100 μA
V_{CEO}(sust)	Collector Emitter Sustaining Voltage (Notes 4 and 5)	30			Volts	I_C = 30 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	I_C = 0 I_E = 100 μA

OTES:

) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C).

) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

) Pulse Conditions: length = 300 μsec; duty cycle ≤ 1%.

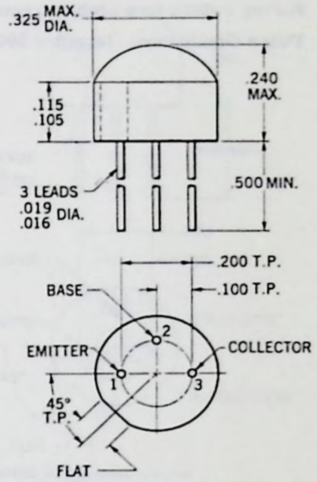
SMALL SIGNAL CHARACTERISTICS (f = 1KC)

Symbol	Characteristic	Typical	Units	Test Conditions	
h_{ie}	Input Resistance	2.5	Kohms	I_C = 10 mA	V_{CE} = 10 V
h_{oe}	Output Conductance	120	μmhos	I_C = 10 mA	V_{CE} = 10 V
h_{fe}	Small Signal Current Gain	500		I_C = 10 mA	V_{CE} = 10 V
h_{re}	Voltage Feedback Ratio	460	$\times 10^{-6}$	I_C = 10 mA	V_{CE} = 10 V

2N3567 · 2N3568
NPN GENERAL PURPOSE TYPES
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

2N3567 and 2N3568 are NPN silicon PLANAR*epitaxial transistors designed pri-rily for amplifier and switching applications over a wide range of voltage and current. ese devices feature a useful beta range to 500 mA and low saturation voltage. High ector-to-emitter voltage allows operation to 60 volts for the 2N3568 and 40 volts for 2N3567.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

OLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 sec. time limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 & 3)	0.8 Watt
at 25°C Ambient Temperature	(Notes 2 & 3)	0.3 Watt

Maximum Voltages		2N3567	2N3568
V_{CBO}	Collector to Base Voltage	80 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

			2N3567			2N3568				
mbol	Characteristic	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	Test Conditions	
E	DC Pulse Current Gain (Note 5)	40	80	120	40	80	120		I_C = 150 mA	V_{CE} = 1.0 V
E	DC Pulse Current Gain (Note 5)	40			40				I_C = 30 mA	V_{CE} = 1.0 V
E(sat)	Collector Saturation Voltage (pulsed, see note 5)		0.15	0.25		0.15	0.25	Volts	I_C = 150 mA	I_B = 15 mA
E(sat)	Base Saturation Voltage (pulsed, see note 5)		0.9	1.1		0.9	1.1	Volts	I_C = 150 mA	I_B = 15 mA
	High Frequency Current Gain (f = 20 MHz)	3.0			3.0				I_C = 50 mA	V_{CE} = 10 V
bo	Open Circuit Output Capacitance		13	20		13	20	pF	I_E = 0	V_{CB} = 10 V
o	Open Circuit Input Capacitance		63	80		63	80	pF	I_C = 0	V_{EB} = 0.5 V
BO	Collector Cutoff Current			50			50	nA	I_E = 0	V_{CB} = 40 V
BO(75°C)	Collector Cutoff Current			5.0			5.0	μA	I_E = 0	V_{CB} = 40 V
BO	Emitter Cutoff Current			25			25	nA	I_C = 0	V_{EB} = 4.0 V
CBO	Collector to Base Breakdown Voltage	80			80			Volts	I_E = 0	I_C = 100 μA
CEO(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40			60			Volts	I_C = 30 mA (pulsed)	I_B = 0
EBO	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	I_C = 0	I_E = 10 μA

* Planar is a patented Fairchild process.

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SMALL SIGNAL CHARACTERISTICS (f=1.0 kHz)

Symbol	Characteristic	Typical	Units	Test Conditions	
h_{ie}	Input Resistance	1800	Ohms	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{oe}	Output Conductance	8.0	μmhos	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{re}	Voltage Feedback Ratio	2.1	$\times 10^{-4}$	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain	60		I_C = 1.0 mA	V_{CE} = 5.0 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C; juncti ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

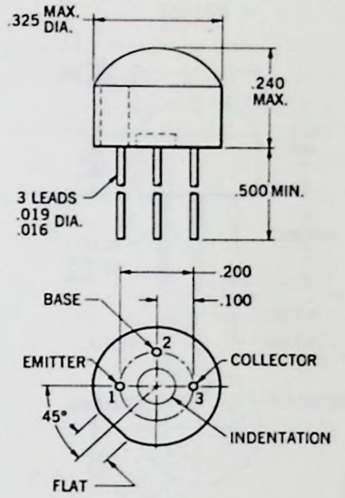
(5) Pulse Conditions: length = 300 μs; duty cycle $\leq$ 1%.

FT3567 • FT3568 • FT3569

NPN GENERAL PURPOSE TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

D . . . . . . 4.0 WATTS AT 25°C CASE TEMPERATURE
V$_{CEO}$ . . . . 60 VOLTS MIN.
FE . . . . . 100 MIN. AT 150 mA
CE(sat) . . . 0.25 VOLT MAX. AT 150 mA

OLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature			
Storage Temperature		−55°C to +125°C	
Operating Junction Temperature		+125°C	
Lead Temperature (Soldering, 10 second time limit)		+260°C	
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		**4.0 Watts**	
at 25°C Ambient Temperature		0.5 Watt	
Maximum Voltages		**FT3567 FT3569**	**FT3568**
V_{CBO}	Collector to Base Voltage	80 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

MBOL	CHARACTERISTICS	FT3567 • FT3568 MIN.	TYP.	MAX.	FT3569 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
FE	**DC Pulse Current Gain** (Note 5)	40	80	120	**100**	150	300		**$I_C = 150$ mA**	**$V_{CE} = 1.0$ V**
FE	DC Pulse Current Gain (Note 5)	40			100				$I_C = 30$ mA	$V_{CE} = 1.0$ V
CE(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		0.15	**0.25**		0.10	**0.25**	Volts	**$I_C = 150$ mA**	**$I_B = 15$ mA**
E(sat)	Pulsed Base Saturation Voltage (Note 5)		0.85	1.1		0.85	1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
e	High Frequency Current Gain (f = 20 MHz)	3.0		15	3.0		15		$I_C = 50$ mA	$V_{CE} = 10$ V
b	Collector to Base Capacitance (FT3567 only)		16	25		16	25	pF	$I_E = 0$	$V_{CB} = 10$ V
b	Collector to Base Capacitance (FT3568 only)		13	20				pF	$I_E = 0$	$V_{CB} = 10$ V
b	Emitter to Base Capacitance		63	80		63	80	pF	$I_C = 0$	$V_{EB} = 0.5$ V
BCO	Collector Cutoff Current			50			50	nA	$I_E = 0$	$V_{CB} = 40$ V
BCO(75°C)	Collector Cutoff Current			5.0			5.0	μA	$I_E = 0$	$V_{CB} = 40$ V
BO	Emitter Cutoff Current			25			25	nA	$I_C = 0$	$V_{EB} = 4.0$ V
CBO	Collector to Base Breakdown Voltage	80			80			Volts	$I_C = 100$ μA	$I_E = 0$
CEO(sus)	Collector to Emitter Sustaining Voltage (Notes 4 and 5) [FT3567 only]	40			40			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
CEO(sus)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5) [FT3568 only]	**60**						**Volts**	**$I_C = 30$ mA**	**$I_B = 0$**
EBO	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_C = 0$	$I_E = 10$ μA
E(on)	Base to Emitter "ON" Voltage			1.1			1.1	Volts	$I_C = 150$ mA	$V_{CE} = 1.0$ V

*Planar is a patented Fairchild process.

S:
hese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
hese are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
hese ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C); junction to ambient thermal esistance of 200°C/Watt (derating factor of 5.0 mW/°C).
his rating refers to a high current point where collector to emitter voltage is lowest.
ulse Conditions: length = 300 μs; duty cycle = 1%.

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SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

		FT3567 • FT3568	FT3569			
SYMBOL	CHARACTERISTICS	TYP.	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	1800	3800	Ω	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance	8.0	19.2	μmhos	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio	2.1	5.6	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain	60	130		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

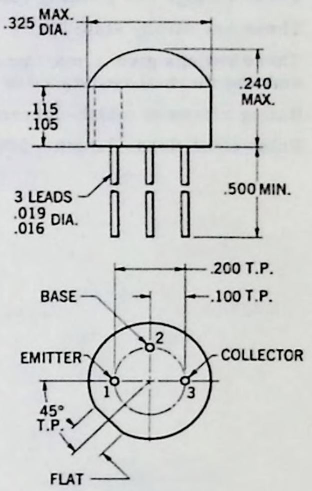
2N3569

NPN GENERAL PURPOSE TYPE

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

The 2N3569 is an NPN silicon **PLANAR** epitaxial transistor designed primarily for amplifier and switching applications over a wide range of voltage and current. This device features a useful beta range to 500 mA and low saturation voltage. High collector-to-emitter voltage allows operation to 40 volts.

PHYSICAL DIMENSIONS
Epoxy package
TO-105



NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature		-55°C to +125°C
Operating Junction Temperature		+125°C Maximum
Lead Temperature (Soldering, 10 sec time limit)		+260°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.8 Watt
at 25°C Free Air Temperature	(Notes 2 and 3)	0.3 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage		80 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage		5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic		Min.	Typ.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain	(Note 5)	100	150	300		I_C = 150 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain	(Note 5)	100				I_C = 30 mA	V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage (pulsed, see note 5)			0.1	0.25	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, see note 5)			0.85	1.1	Volts	I_C = 150 mA	I_B = 15 mA
h_{fe}	High Frequency Current Gain (f = 20 Mc)		3.0				I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Common Base Open Circuit Output Capacitance			18	20	pf	I_E = 0	V_{CB} = 10 V
C_{ibo}	Common Base Open Circuit Input Capacitance			44	80	pf	I_C = 0	V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current				50	nA	I_E = 0	V_{CB} = 40 V
I_{CBO}(75°C)	Collector Cutoff Current				5.0	µA	I_E = 0	V_{CB} = 40 V
I_{EBO}	Emitter Cutoff Current				25	nA	I_C = 0	V_{EB} = 4.0 V
BV_{CBO}	Collector to Base Breakdown Voltage		80			Volts	I_C = 100 µA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)		40			Volts	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage		5.0			Volts	I_E = 10 µA	I_C = 0

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FAIRCHILD TRANSISTOR 2N3569

SMALL SIGNAL CHARACTERISTICS (f=1.0KC)

Symbol	Characteristic	Typical	Units	Test Conditions	
h_{ie}	Input Resistance	3800	Ohms	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{oe}	Output Conductance	19.2	μmhos	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{re}	Voltage Feedback Ratio	5.6	$\times 10^{-4}$	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain	130		I_C = 1.0 mA	V_{CE} = 5.0 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C; juncti ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

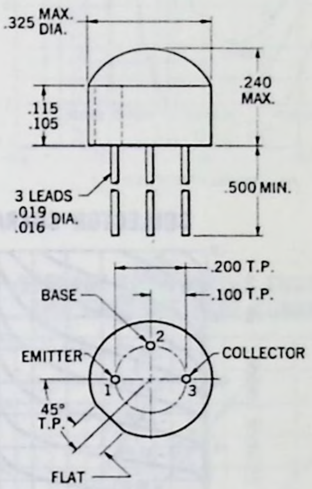
(5) Pulse Conditions: length = 300 μsec; duty cycle $\leq$ 1%.

2N3638 · 2N3638A

PNP HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

PHYSICAL DIMENSIONS
Epoxy package
TO-105



NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

- **FAST SWITCHING - - $t_{on} = 75$ ns (max.) @ 300 mA**
- **- - $t_{off} = 170$ ns (max.) @ 300 mA**
- **HIGH BETA - - h_{FE} 100 (min.) @ $I_C = 50$ mA**
- **HIGH CURRENT - - Up to 500 mA**
- **LOW V_{CE}(sat) - - 1.0 Volt (max.) @ 300 mA**
- **LOW COST IN ALL QUANTITIES**

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
Storage Temperature			−55°C to +125°C
Operating Junction Temperature			+125°C Maximum
Lead Temperature (Soldering, 10 sec time limit)			+260°C Maximum
Maximum Power Dissipation			
Total Dissipation at 25°C Case Temperature		(Notes 2 and 3)	0.7 Watt
at 25°C Free Air Temperature		(Notes 2 and 3)	0.3 Watt
Maximum Voltages and Current			
V_{CBO}	Collector to Base Voltage		−25 Volts
V_{CES}	Collector to Emitter Voltage		−25 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	−25 Volts
V_{EBO}	Emitter to Base Voltage		−4.0 Volts
I_C	Collector Current	(Note 2)	500 mA

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	2N3638 MIN.	2N3638 TYP.	2N3638 MAX.	2N3638A MIN.	2N3638A TYP.	2N3638A MAX.	UNITS	TEST CONDITIONS	
FE	DC Pulse Current Gain (Note 5)				80	140			$I_C = 1.0$ mA	$V_{CE} = -10$V
FE	DC Pulse Current Gain (Note 5)	20	70		100	160			$I_C = 10$ mA	$V_{CE} = -10$V
FE	**DC Pulse Current Gain** (Note 5)	30	67		**100**	**130**			**$I_C = 50$ mA**	**$V_{CE} = -1.0$ V**
FE	DC Pulse Current Gain (Note 5)	20	40		20	50			$I_C = 300$ mA	$V_{CE} = -2.0$ V
$_{CE}$(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.08	−0.25		−0.08	−0.25	Volt	$I_C = 50$ mA	$I_B = 2.5$ mA
$_{CE}$(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		−0.38	−1.0		**−0.38**	**−1.0**	**Volt**	**$I_C = 300$ mA**	**$I_B = 30$ mA**
$_{CEO}$(sust)	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	−25			−25			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
V_{CBO}	Collector to Base Breakdown Voltage	−25			−25			Volts	$I_C = 100$ μA	$I_E = 0$
V_{CES}	Collector to Emitter Breakdown Voltage	−25			−25			Volts	$I_C = 100$ μA	$V_{EB} = 0$
on	**Turn On Time** (Note 6)		28	75		**28**	**75**	**ns**	**$I_C \approx 300$ mA**	$I_{B1} \approx 30$ mA
off	**Turn Off Time** (Note 6)		110	170		**110**	**170**	**ns**	**$I_C \approx 300$ mA**	$I_{B1} \approx 30$ mA $I_{B2} \approx -30$ mA
fe	**High Frequency Current Gain (f = 100 MHz)**	1.0	1.9		**1.5**	**1.9**			**$I_C = 50$ mA**	$V_{CE} = -3.0$ V
cbo	Common-Base, Open-Circuit Output Capacitance		6.0	20		**6.0**	**10**	**pF**	$I_E = 0$	$V_{CB} = -10$ V
ibo	Common-Base, Open-Circuit Input Capacitance		18	65		18	25	pF	$I_C = 0$	$V_{EB} = -0.5$ V

*Planar is a patented Fairchild process.

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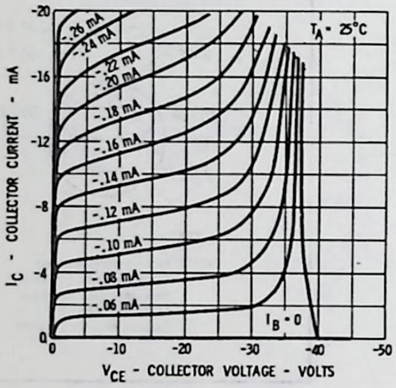
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{BE}(sat)	Base-Emitter Saturation Voltage (pulsed, Note 5)		−0.9	−1.1	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{BE}(sat)	Base-Emitter Saturation Voltage (pulsed, Note 5)	−0.8	−1.25	−2.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	$I_E = 100\ \mu$A	$I_C = 0$
I_{CES}	Collector Reverse Current		0.1	35	nA	$V_{CE} = -15$ V	$V_{EB} = 0$
I_{CES}(65°C)	Collector Reverse Current		0.002	2.0	μA	$V_{CE} = -15$ V	$V_{EB} = 0$

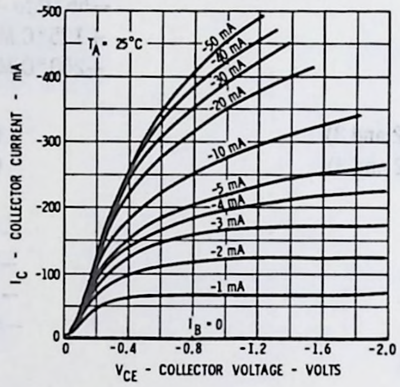
TYPICAL ELECTRICAL CHARACTERISTICS

2N3638

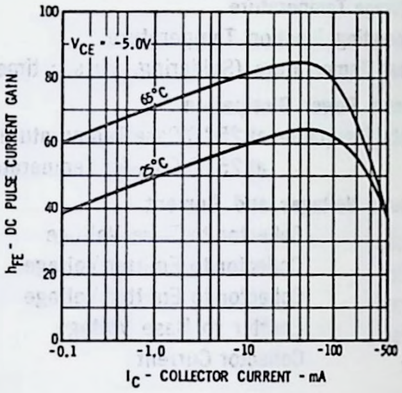
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*

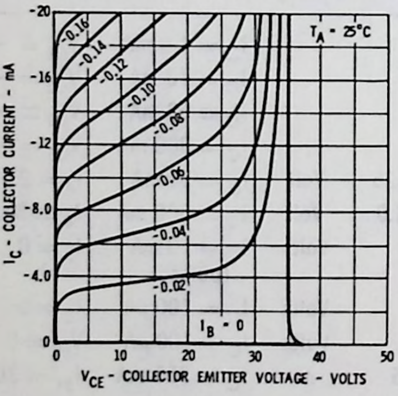


DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

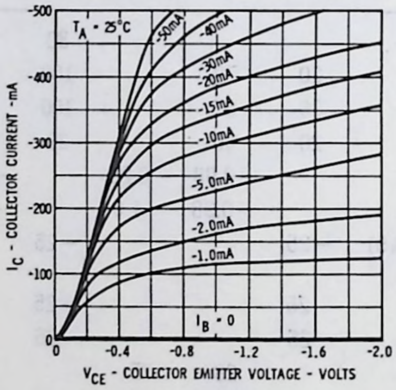


2N3638A

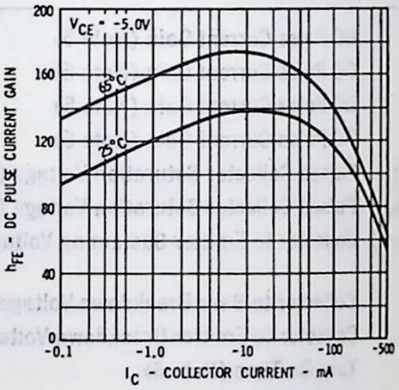
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*

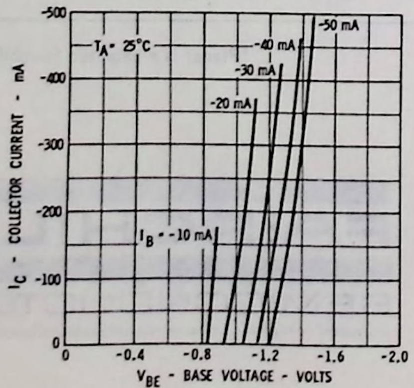


DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

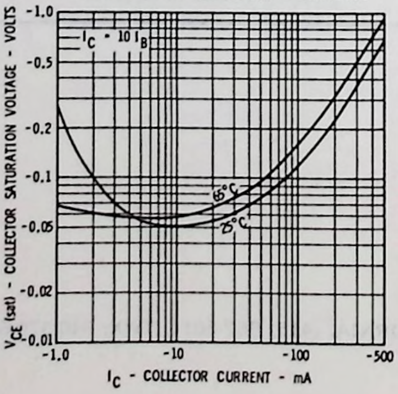


2N3638 • 2N3638A

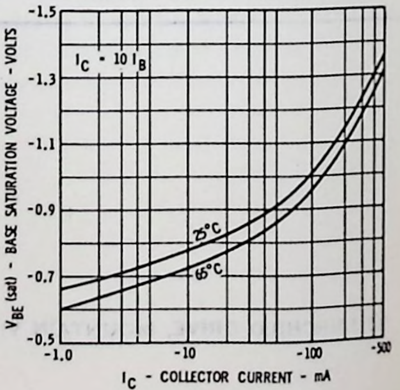
BASE CHARACTERISTICS*



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



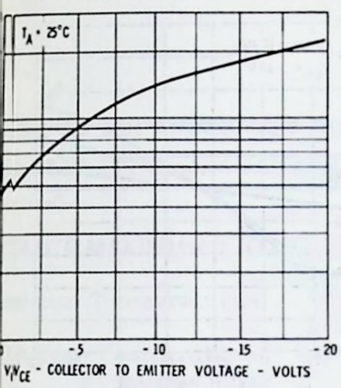
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



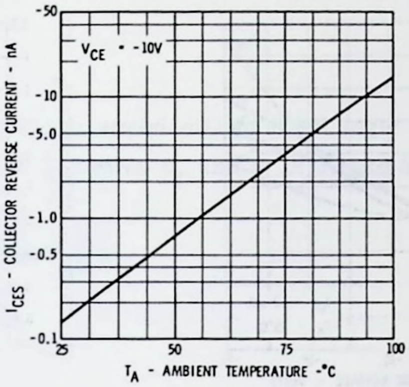
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

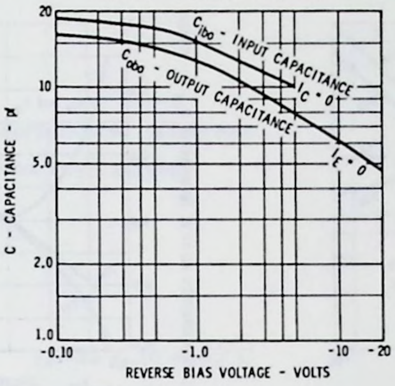
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



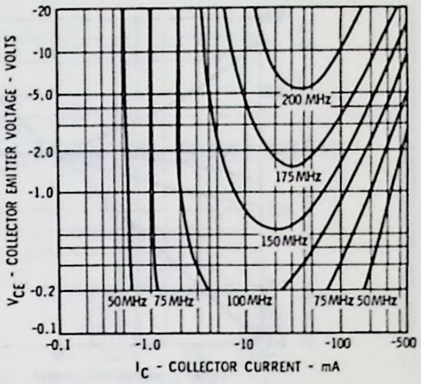
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



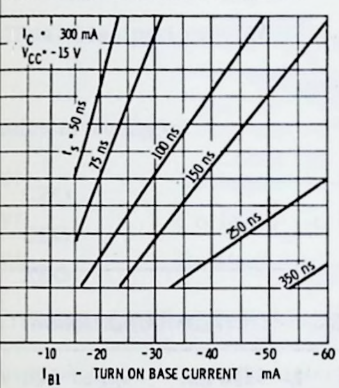
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



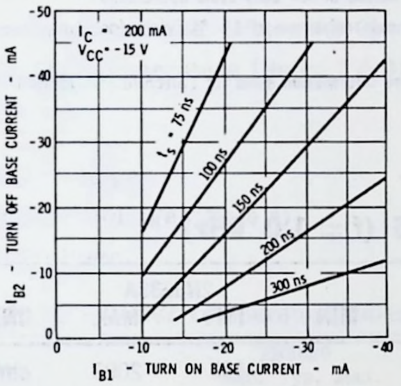
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



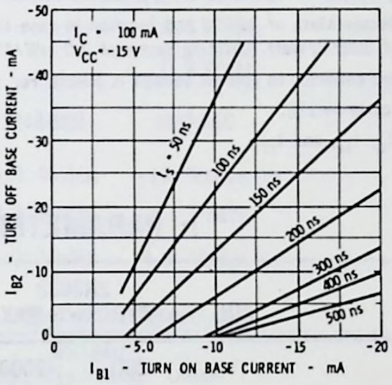
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



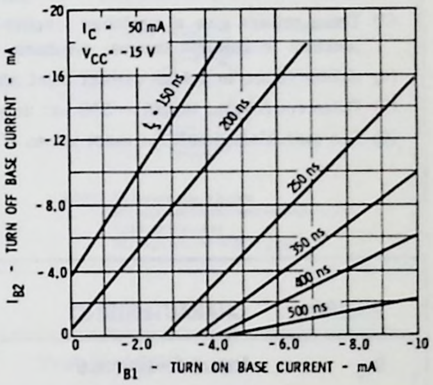
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



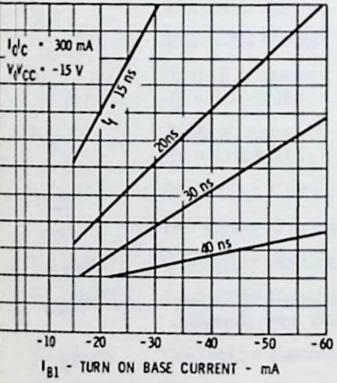
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



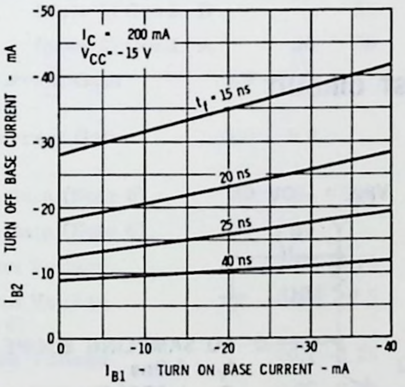
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



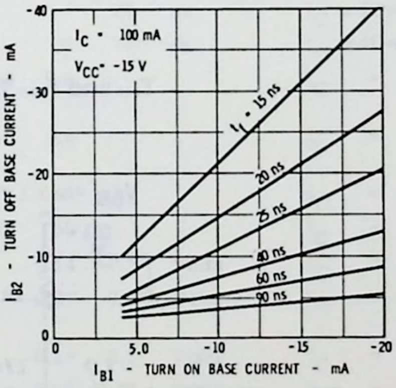
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



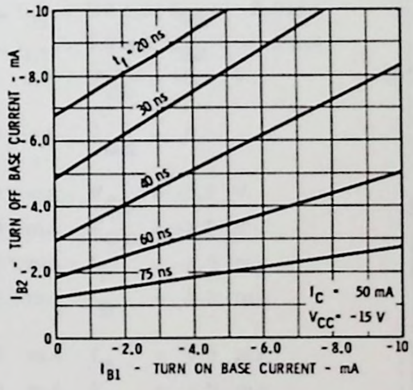
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



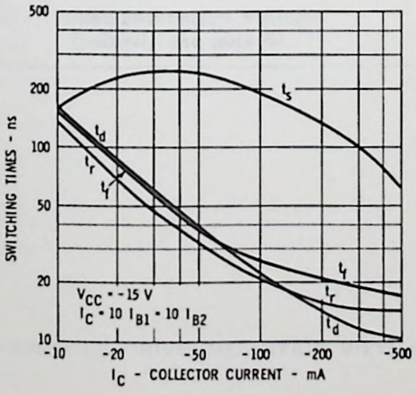
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



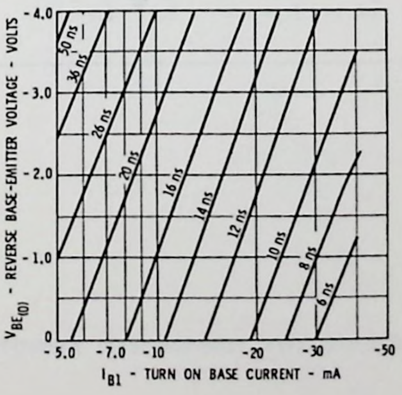
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



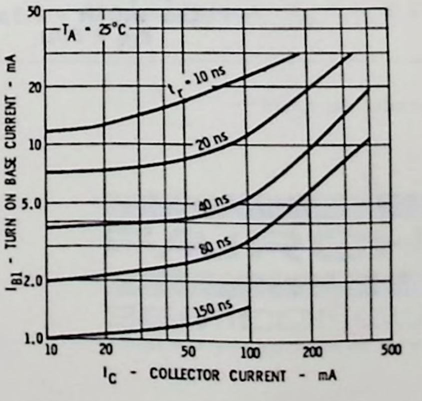
SWITCHING TIMES VERSUS COLLECTOR CURRENT



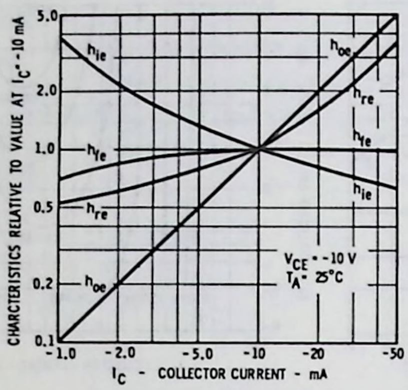
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE

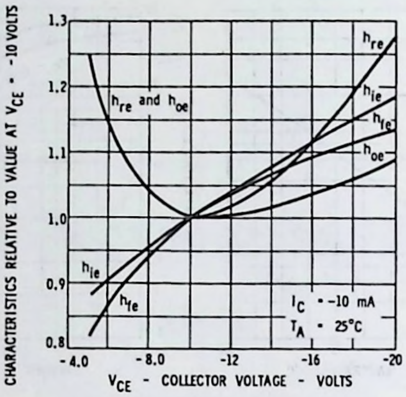


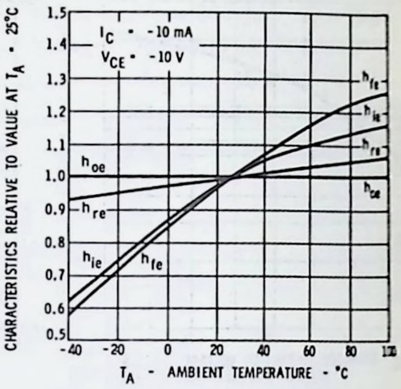
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



SMALL SIGNAL CHARACTERISTICS







NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 14 °C/Watt (derating factor of 7.0mW/°C); junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C).

(4) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

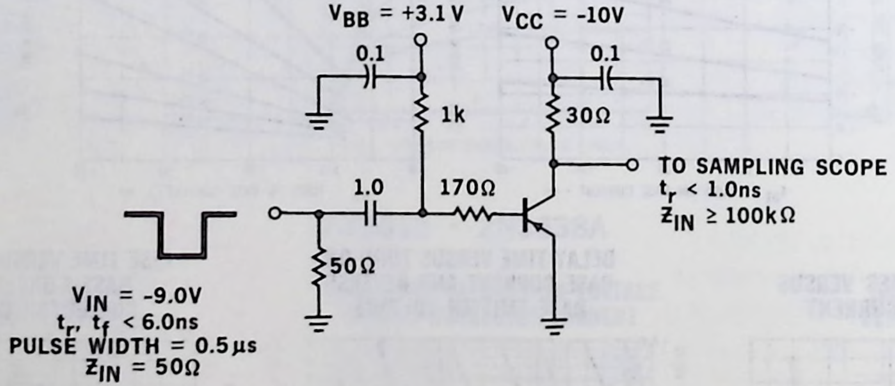
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

h PARAMETERS (f = 1.0 kHz)

		2N3638			2N3638A					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance		200	2000		480	2000	ohms	I_C =10 mA	$V_{CE} = -10V$
h_{oe}	Output Conductance		80	1200		80	1200	μmhos	I_C =10 mA	$V_{CE} = -10V$
h_{re}	Voltage Feedback Ratio		162	2600		162	1500	$x10^{-6}$	I_C =10 mA	$V_{CE} = -10V$
h_{fe}	Small Signal Current Gain	25	74		100	180			I_C =10 mA	$V_{CE} = -10V$

T



2N3639 • 2N3640

PNP HIGH-SPEED LOGIC SWITCHES

SILICON PLANAR* EPITAXIAL TRANSISTORS

e 2N3639 and 2N3640 are very high speed silicon PNP logic transistors. They are taxial PLANAR* units and feature 500 MHz f_T and τ_s of 30 and 50 ns respectively.

SOLUTE MAXIMUM RATINGS [Note 1]

aximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 sec time limit)	+260°C Maximum

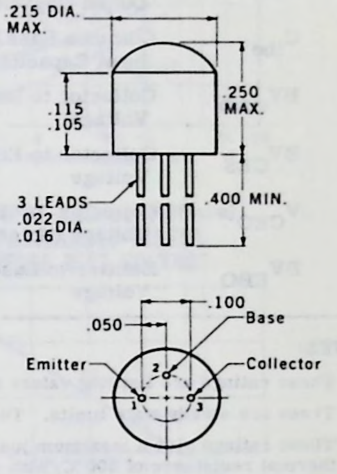
aximum Power Dissipation

Total Dissipation at 25°C Case Temperatures (Notes 2 & 3)	0.5 Watt
at 25°C Free Air Temperature (Notes 2 & 3)	0.2 Watt

aximum Voltages

		2N3639	2N3640
V_{CBO}	Collector to Base Voltage	-6.0 Volts	-12 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-6.0 Volts	-12 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts	-4.0 Volts

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
All leads electrically isolated from case
Leads are nickel
Package weight is 0.31 gram

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3639 Min.	2N3639 Typ.	2N3639 Max.	2N3640 Min.	2N3640 Typ.	2N3640 Max.	Units	Test Conditions
τ_s	Charge Storage time (Note 5) Cond. C			30			50	ns	$I_C \approx 10$ mA, $I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA
t_{on}	Turn On Time (Note 5) Cond. B			25			25	ns	$I_C \approx 50$ mA $I_{B1} \approx 5.0$ mA
t_{on}	Turn On Time (Note 5) Cond. A		26	60		26	60	ns	$I_C \approx 10$ mA $I_{B1} \approx 0.5$ mA
t_{off}	Turn Off Time (Note 5) Cond. B			25			35	ns	$I_C \approx 50$ mA, $I_{B1} \approx 5.0$ mA, $I_{B2} \approx -5.0$ mA
t_{off}	Turn Off Time (Note 5) Cond. A		38	60		38	75	ns	$I_C \approx 10$ mA, $I_{B1} \approx 0.5$ mA, $I_{B2} \approx -0.5$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	5.0	7.5		5.0	7.5			$I_C = 10$ mA $V_{CE} = -5.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	6.0		3.0	6.0			$I_C = 10$ mA $V_{CB} = 0$
h_{FE}	DC Pulse Current Gain (Note 6)	30	63	120	30	63	120		$I_C = 10$ mA $V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain (Note 6)	20	50		20	50			$I_C = 50$ mA $V_{CE} = -1.0$ V
V_{CE}(sat)	Collector Saturation Voltage		-0.07	-0.16		-0.14	-0.2	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage (pulsed, see note 6)		-0.19	-0.5		-0.37	-0.6	Volts	$I_C = 50$ mA $I_B = 5.0$ mA
V_{CE}(sat)	Collector Saturation Voltage		-0.1	-0.25		-0.18	-0.3	Volts	$I_C = 10$ mA $I_B = 0.5$ mA
V_{CE}(sat)	Collector Saturation Voltage ($T_A = +65°C$)		-0.08	-0.23		-0.15	-0.25	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage	-0.75	-0.9	-0.95	-0.75	-0.9	-0.95	Volts	$I_C = 10$ mA $I_B = 0.5$ mA
V_{BE}(sat)	Base Saturation Voltage	-0.8	-0.9	-1.0	-0.8	-0.9	-1.0	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, see note 6)		-1.1	-1.5		-1.1	-1.5	Volts	$I_C = 50$ mA $I_B = 5.0$ mA

* Planar is a patented Fairchild process.

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FAIRCHILD TRANSISTORS 2N3639 • 2N3640

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3639 Min.	2N3639 Typ.	2N3639 Max.	2N3640 Min.	2N3640 Typ.	2N3640 Max.	Units	Test Conditions
I_{CES}	Collector Reverse Current		0.02	10				nA	V_{CE} = -3.0 V V_{EB} = 0
I_{CES}	Collector Reverse Current					0.05	10	nA	V_{CE} = -6.0 V V_{EB} = 0
I_{CES}	Collector Reverse Current (T_A = +65°C)		0.02	1.0				μA	V_{CE} = -3.0 V V_{EB} = 0
I_{CES}	Collector Reverse Current (T_A = +65°C)					0.05	1.0	μA	V_{CE} = -6.0 V_{EB} = 0
C_{obo}	Common Base Open Circuit Output Capacitance		1.85	3.5		1.85	3.5	pF	I_E = 0 V_{CB} = -5.0 V
C_{obo}	Common Base Open Circuit Output Capacitance		2.5	5.5		2.5	5.5	pF	I_E = 0 V_{CB} = 0
C_{ibo}	Common Base Open Circuit Input Capacitance		1.8	3.5		1.8	3.5	pF	I_C = 0 V_{EB} = -0.5 V
BV_{CBO}	Collector to Base Breakdown Voltage	-6.0			-12			Volts	I_C = 100 μA I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	-6.0			-12			Volts	I_C = 100 μA V_{EB} = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 6)	-6.0			-12			Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			-4.0			Volts	I_E = 100 μA I_C = 0

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-to-a thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

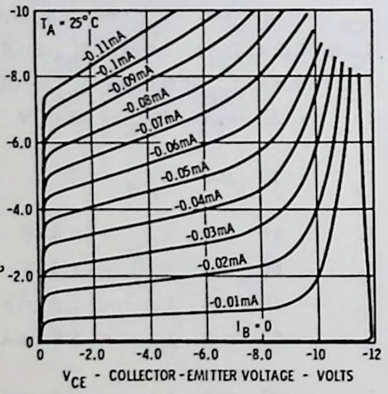
(5) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

(6) Pulse Conditions: length = 300 μs; duty cycle = 1%.

TYPICAL COLLECTOR CHARACTERISTICS*

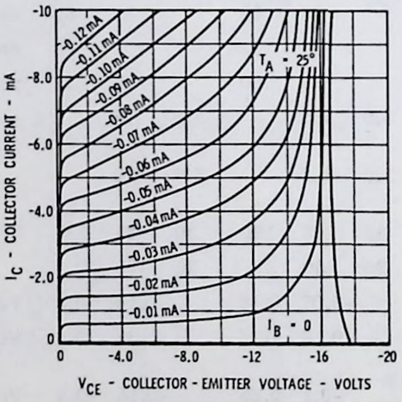
2N3639

ACTIVE REGION



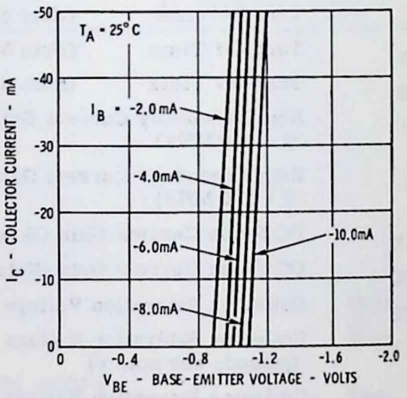
2N3640

ACTIVE REGION

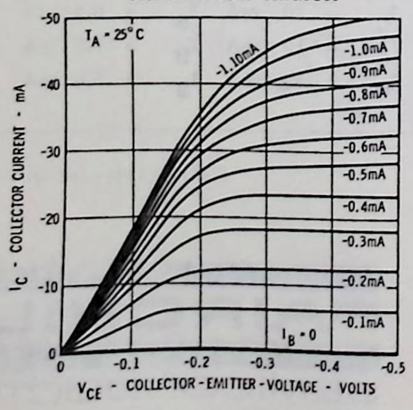


2N3639 2N3640

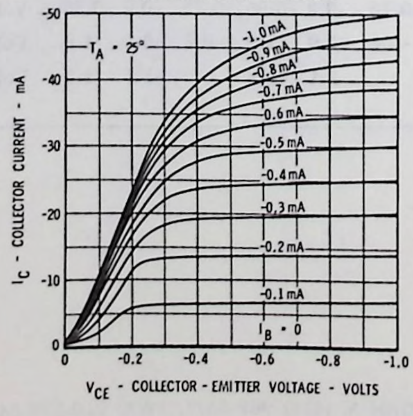
BASE CHARACTERISTICS*



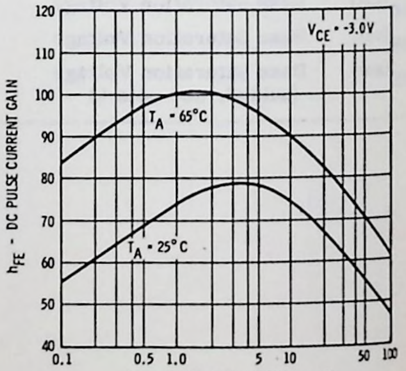
SATURATION REGION



SATURATION REGION



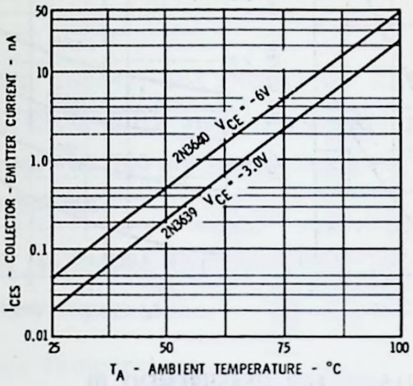
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



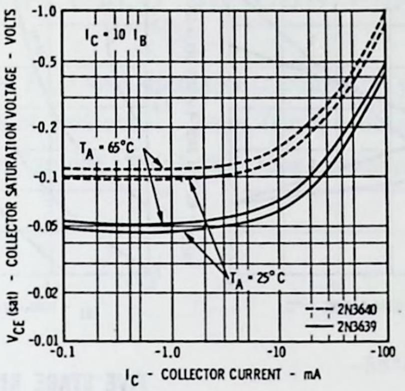
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

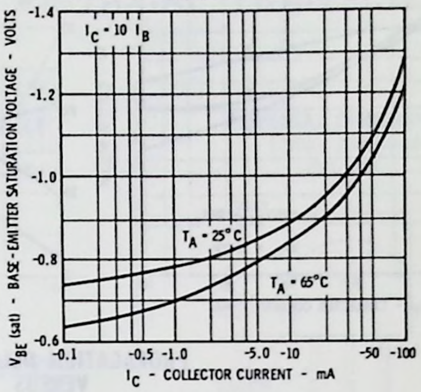
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



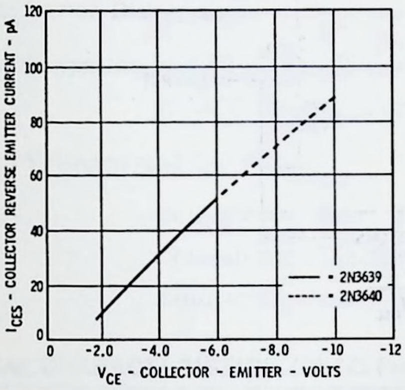
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



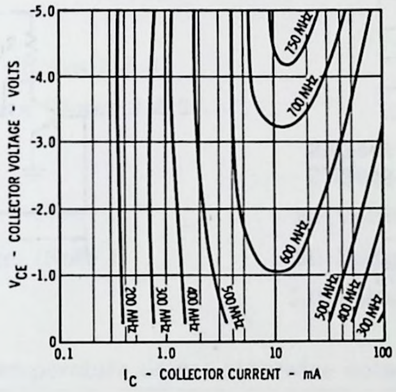
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



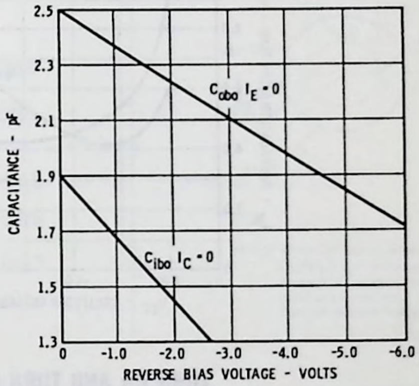
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



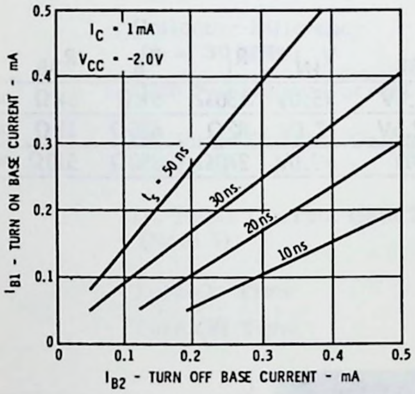
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



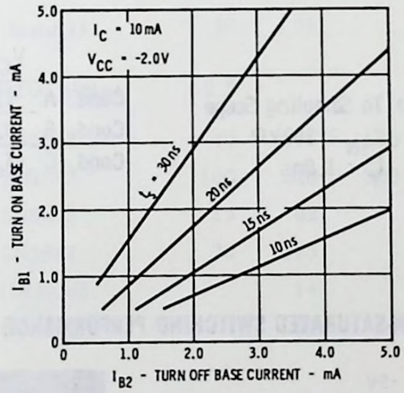
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



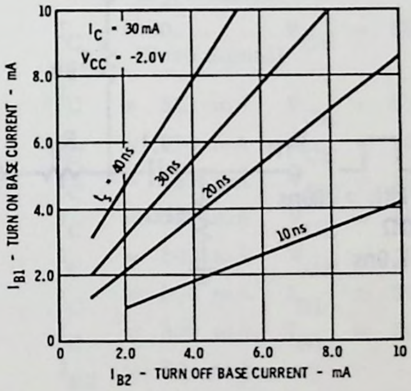
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



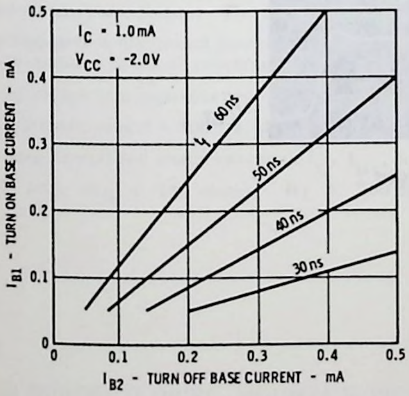
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



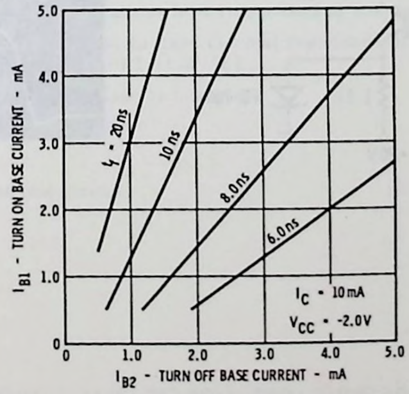
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



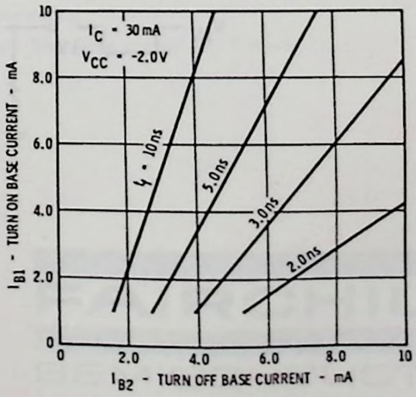
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



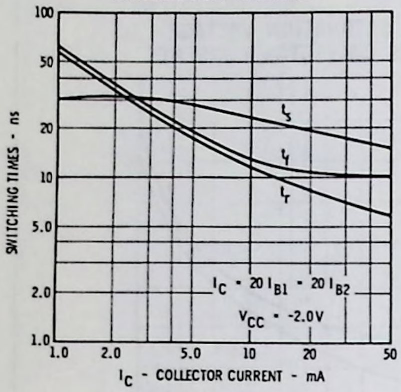
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



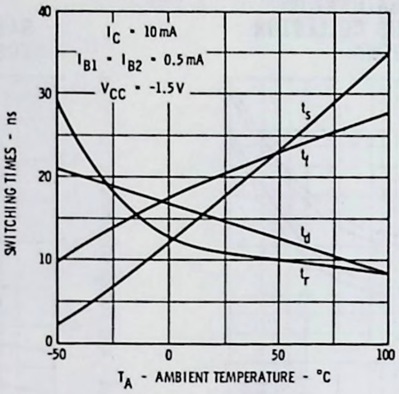
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



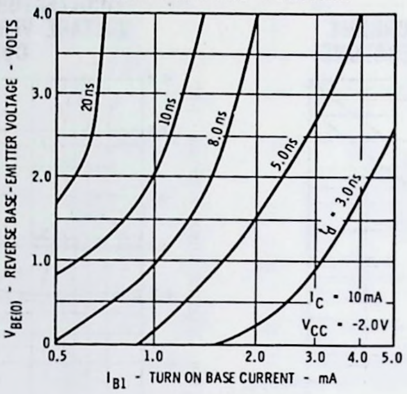
SWITCHING TIMES VERSUS COLLECTOR CURRENT



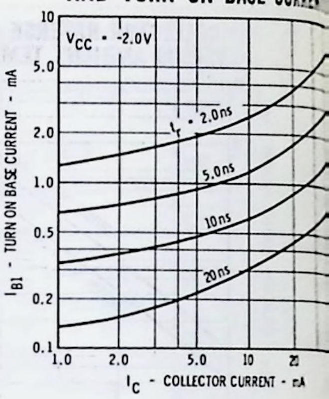
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



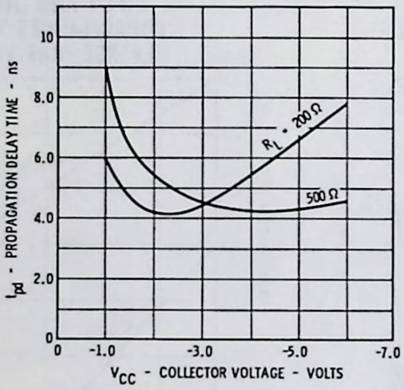
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



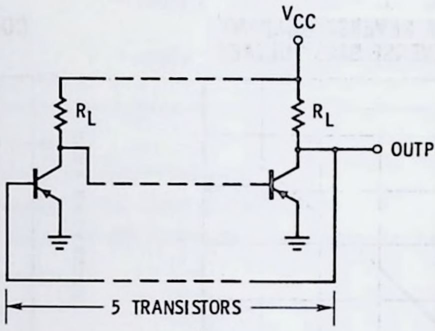
RISE TIME VERSUS COLLECT AND TURN ON BASE CURR



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE

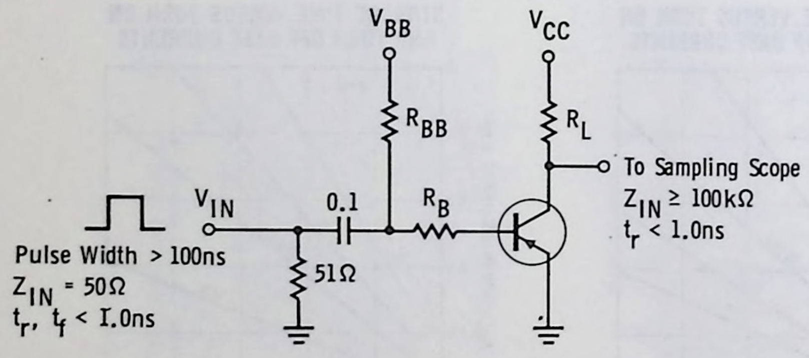


FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY


V_{CC}
R_L
R_L
OUTPUT
5 TRANSISTORS

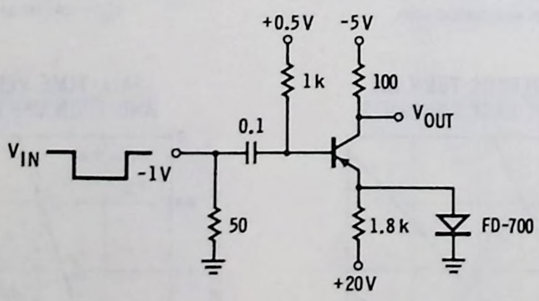
$$t_{pd} = \frac{1}{10 f_{osc}}$$

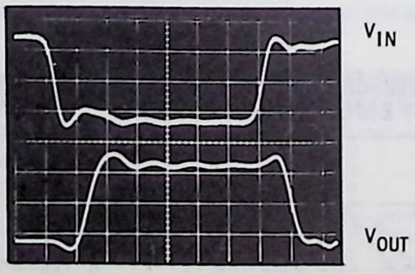
TURN ON AND TURN OFF TEST CIRCUIT


V_{BB}
V_{CC}
R_{BB}
R_L
V_{IN}
0.1
R_B
51Ω
To Sampling Scope
$Z_{IN} \geq 100kΩ$
$t_r < 1.0ns$
Pulse Width > 100ns
$Z_{IN} = 50Ω$
t_r, $t_f < 1.0ns$

	V_{CC}	V_{BB}	V_{IN}	R_L	R_B	R_{BB}	I_C
Cond. A	-1.5V	-6.0V	+5.0V	130Ω	5kΩ	5kΩ	≈ 10mA
Cond. B	-4.5V	+2.5V	-7.0V	82Ω	680Ω	1kΩ	≈ 50mA
Cond. C	-3.0V	-10V	+9.0V	270Ω	390Ω	510Ω	≈ 10mA

NON-SATURATED SWITCHING PERFORMANCE


+0.5V
-5V
1k
100
V_{OUT}
0.1
V_{IN}
-1V
50
1.8k
FD-700
+20V



2 ns / division

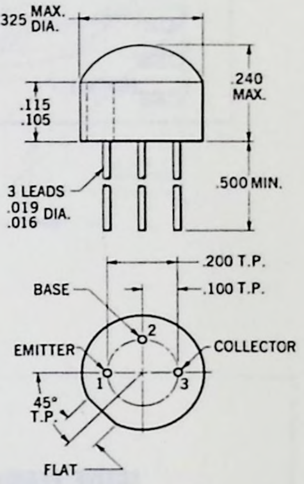
2N3641 • 2N3642 • 2N3643

NPN CLASS-C RF AMPLIFIERS AND HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

he 2N3641, 2N3642, and 2N3643 are NPN silicon PLANAR epitaxial transistors designed for ervice as Class-C RF amplifiers and high current switches. They feature outstanding RF rformance with 700 mW power output at 30 MHz typical. Total switching times are 94 nsec pical at 300 mA.

PHYSICAL DIMENSIONS
Epoxy package
TO-105



NOTES All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

laximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	125°C Maximum
Lead Temperature (Soldering 1/16" ±1/32", 10 sec time limit)	260°C Maximum

laximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 & 3)	0.7 Watt
at 25°C Ambient Temperature (Notes 2 & 3)	.35 Watt

laximum Voltages and Current		2N3641 2N3643	2N3642
V_{CBO}	Collector to Base Voltage	60 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	45 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic		Min.	Typ.	Max.	Units	Test Conditions
G_{PE}	Amplifier Power-Gain (f = 30 MHz)	(Note 7)	10	12		dB	I_C = 0 (Zero Signal) V_{CE} = 15 V
η	Collector Efficiency (f = 30 MHz)	(Note 7)	60	75		%	I_C = 0 (Zero Signal) V_{CE} = 15 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)		2.5				I_C = 50 mA V_{CE} = 5.0 V
h_{FE}	DC Pulse Current Gain 2N3641 (Note 5)	2N3642	40	75	120		I_C = 150 mA V_{CE} = 10 V
		2N3643	100	220	300		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain 2N3641 (Note 5)	2N3642	15	62			I_C = 500 mA V_{CE} = 10 V
		2N3643	25	125			I_C = 500 mA V_{CE} = 10 V
t_{on}	Turn On Time	(Note 6)		14		nsec	I_C ≈ 300 mA I_{B1} ≈ 30 mA
t_{off}	Turn Off Time	(Note 6)		80		nsec	I_C ≈ 300 mA, I_{B1} ≈ 30 mA I_{B2} ≈ -30 mA

* Planar is a patented Fairchild process.

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 143°C/Watt (derating factor of 7.0 mW/°C); junction-to-ambient thermal resistance of 286°C / Watt (derating factor of 3.5 mW/°C).

This rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

P_{IN} = 40 mW, R_G = 140 ohms, R_L = 260 ohms, see test circuit.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

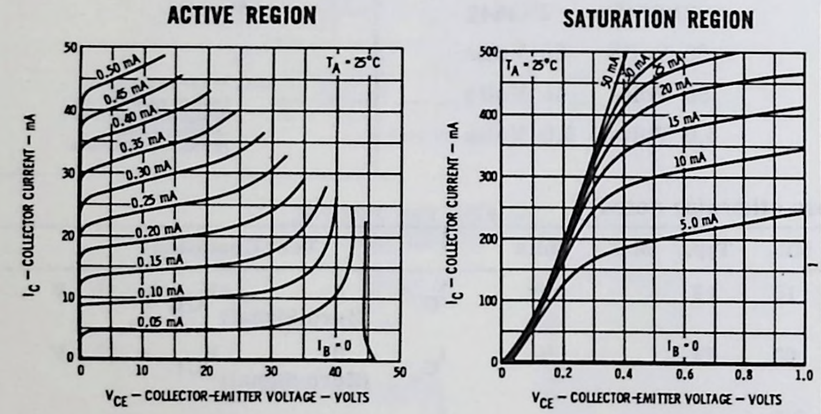
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
BV_{CBO}	Collector to Base Breakdown Voltage	60			Volts	I_C = 10 μA I_E = 0
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Notes 4 & 5) 2N3641 2N3643	30			Volts	I_C = 10 mA I_B = 0
	2N3642	45			Volts	I_C = 10 mA I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	I_C = 0 I_E = 10 μA
C_{obo}	Output Capacitance			8.0	pF	I_E = 0 V_{CB} = 10 V
$V_{CE}(sat)$	Collector Saturation Voltage		0.13	0.22	Volts	I_C = 150 mA I_B = 15 mA
$V_{CE}(sat)$	Collector Saturation Voltage		0.35		Volts	I_E = 500 mA I_B = 50 mA
I_{CES}	Collector Reverse Current			0.05	μA	V_{CE} = 50 V V_{EB} = 0
$I_{CES}(65°C)$	Collector Reverse Current			1.0	μA	V_{CE} = 50 V V_{EB} = 0

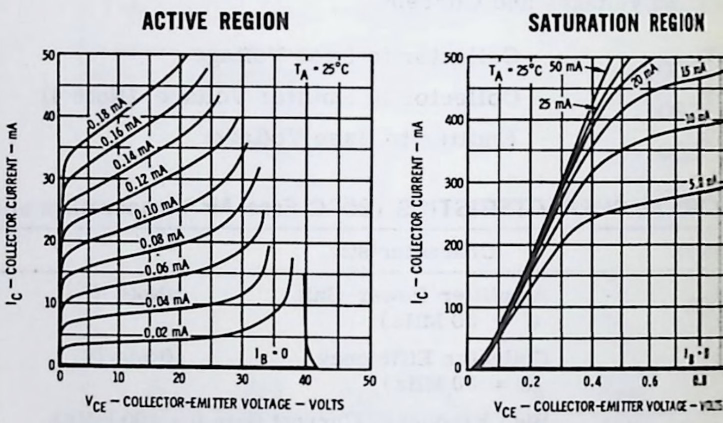
TYPICAL ELECTRICAL CHARACTERISTICS

COLLECTOR CHARACTERISTICS*

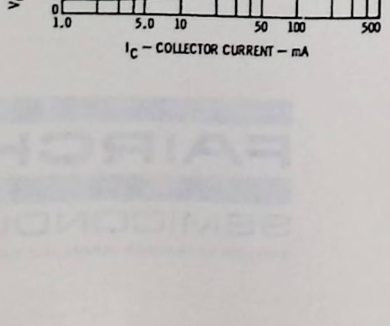
2N3641 • 2N3642



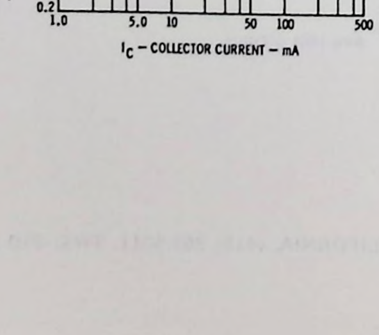
2N3643



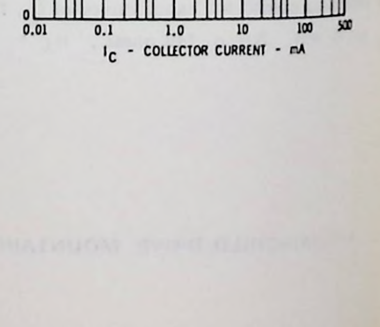
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTION CURRENT

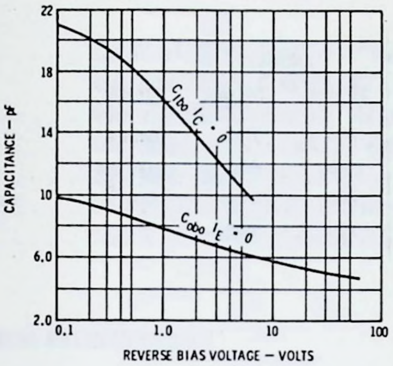


PULSE DC CURRENT GAIN VERSUS COLLECTOR CURRENT

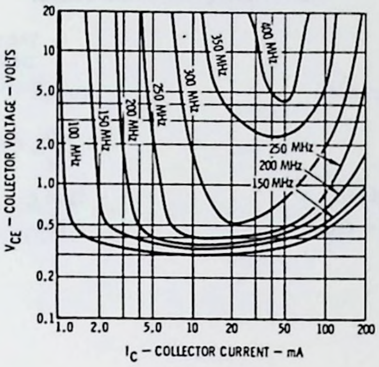


TYPICAL ELECTRICAL CHARACTERISTICS

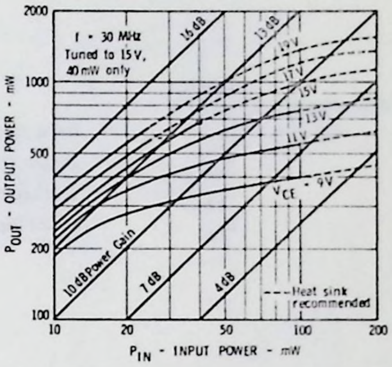
EMITTER TRANSITION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



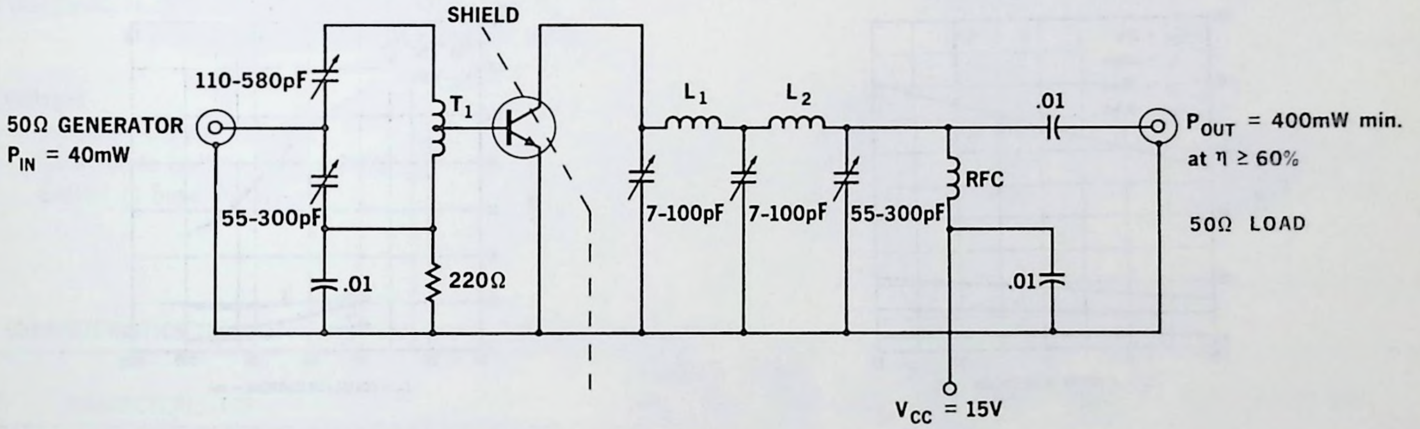
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



TYPICAL POWER IN VERSUS POWER OUT



30 MC AMPLIFIER TEST CIRCUIT

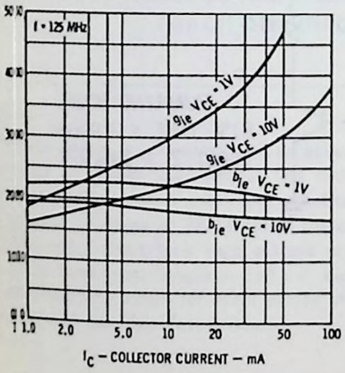

SHIELD
110-580pF
50Ω GENERATOR
P_{IN} = 40mW
T_1
55-300pF
.01
220Ω
L_1
L_2
7-100pF
7-100pF
55-300pF
RFC
.01
.01
V_{CC} = 15V
P_{OUT} = 400mW min.
at η ≥ 60%
50Ω LOAD

T_1 - 4 Turns no. 20 Wire, ¾" Dia. x ¼" Long, Midtapped.

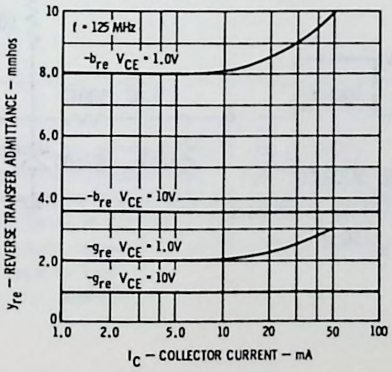
L_1 and L_2 - 4 Turns no. 20 Wire, ½" Dia. x ¼" Long.

Variable Capacitors are Compression Mica.

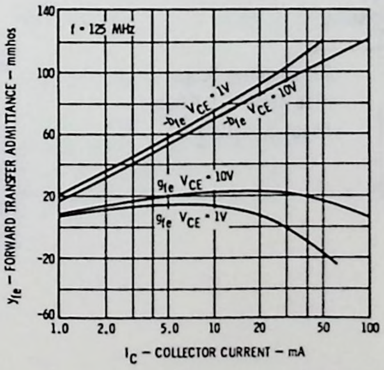
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



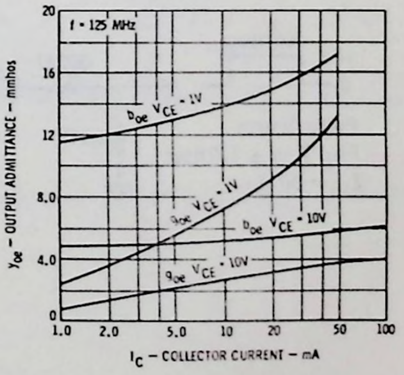
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT — INPUT SHORT CIRCUIT

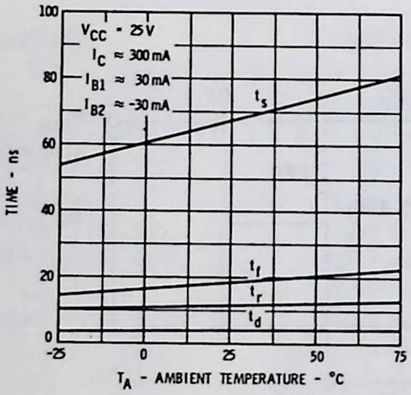


TYPICAL ELECTRICAL CHARACTERISTICS

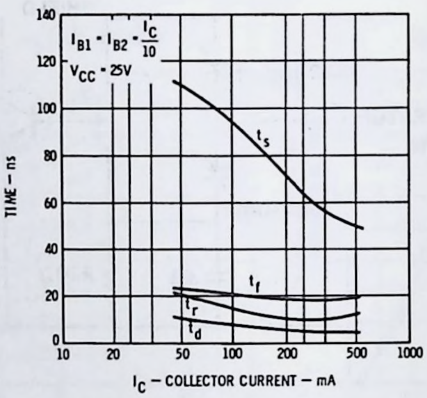
TYPICAL SMALL SIGNAL CHARACTERISTICS (F = 1 kHz, V_{CE} = 10 VOLTS)

Symbol	Characteristic	2N3641 2N3642 I_C = 10 mA	2N3641 2N3642 50 mA	2N3643 10 mA	2N3643 50 mA	Units
h_{ie}	Input Resistance	460	350	950	880	Ohms
h_{oe}	Output Conductance	55	405	83	660	μmhos
h_{re}	Voltage Feedback Ratio	130	500	205	1500	x10^{-6}
h_{fe}	Small Signal Current Gain	90	97	170	220	

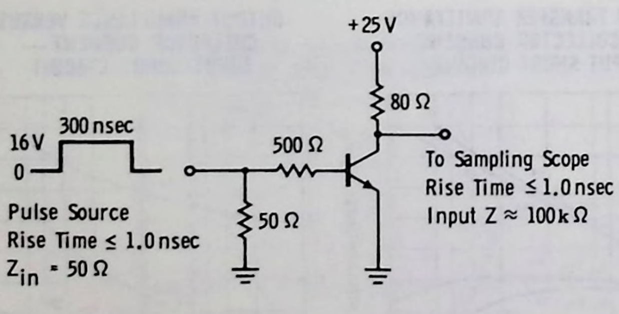
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIMES VERSUS COLLECTOR CURRENT

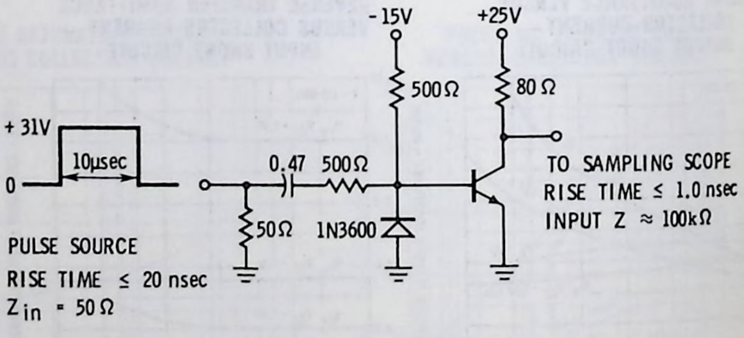


TURN-ON TEST CIRCUIT



+25 V
80 Ω
16 V
300 nsec
0
500 Ω
50 Ω
To Sampling Scope
Rise Time ≤ 1.0 nsec
Input Z ≈ 100k Ω
Pulse Source
Rise Time ≤ 1.0 nsec
Z_{in} = 50 Ω

TURN-OFF TEST CIRCUIT



-15V
+25V
500 Ω
80 Ω
+ 31V
10µsec
0
0.47
500 Ω
50Ω
1N3600
TO SAMPLING SCOPE
RISE TIME ≤ 1.0 nsec
INPUT Z ≈ 100k Ω
PULSE SOURCE
RISE TIME ≤ 20 nsec
Z_{in} = 50 Ω

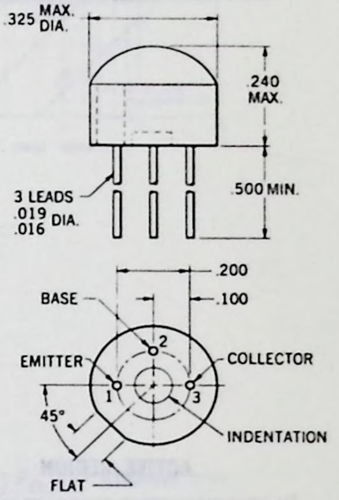
FT3641 • FT3642 • FT3643

NPN CLASS-C RF AMPLIFIERS AND HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

P_d	3.0 W AT 25°C CASE TEMPERATURE 450 mW AT 25°C AMBIENT TEMPERATURE
HIGH GAIN	400 mW RF POWER OUT AT 30 MHz
HIGH BETA	100 (MIN) AT 150 mA, 25 (MIN) AT 500 mA
HIGH f_T	250 MHz (MIN) AT 50 mA
FAST SWITCHING . . .	60 ns (MAX) t_{on} AND 150 ns (MAX) t_{off} AT 300 mA
LOW $V_{CE(sat)}$	0.22 V (MAX) AT 150 mA, 0.35 V (TYP) AT 500 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO 105) outline



NOTES All dimensions in inches
Leads are gold plated nickel
Package is electrically Non conductive material
Package weight is 0.66 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	125°C
Lead Temperature (Soldering, 10 second time limit)	260°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	3.0 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.45 Watt

Maximum Voltages		**FT3642**	**FT3641 FT3643**
V_{CBO}	Collector to Base Voltage	60 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	45 Volts	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FT3641 • FT3642			FT3643					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
G_{pe}	**Amplifier Power Gain (f = 30 MHz)** (Note 7)	**10**	**12**		**10**	**12**		**dB**	**$I_C = 0$** (zero signal)	**$V_{CE} = 15$ V**
η	Collector Efficiency (f = 30 MHz) (Note 7)	60	75		60	75		%	$I_C = 0$ (zero signal)	$V_{CE} = 15$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**2.5**		**8.0**	**2.5**		**8.0**		**$I_C = 50$ mA**	**$V_{CE} = 5.0$ V**
h_{FE}	**DC Pulse Current Gain** (Note 5)	**40**	**75**	**120**	**100**	**220**	**300**		$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	15	62		25	125			**$I_C = 500$ mA**	**$V_{CE} = 10$ V**
t_{on}	Turn On Time (Note 6)		14	60		14	60	ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	Turn Off Time (Note 6)		80	150		80	150	ns	$I_C \approx 300$ mA $I_{B2} \approx -30$ mA	$I_{B1} \approx 30$ mA

* Planar is a patented Fairchild process.

OTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 33.3°C/Watt (derating factor of 30 mW/°C); junction to ambient thermal resistance of 222°C/Watt (derating factor of 22.2 mW/°C).
4) This rating refers to a high current point where collector to emitter voltage is lowest.
5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.
7) $P_{IN} = 40$ mW. See Test Circuit.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

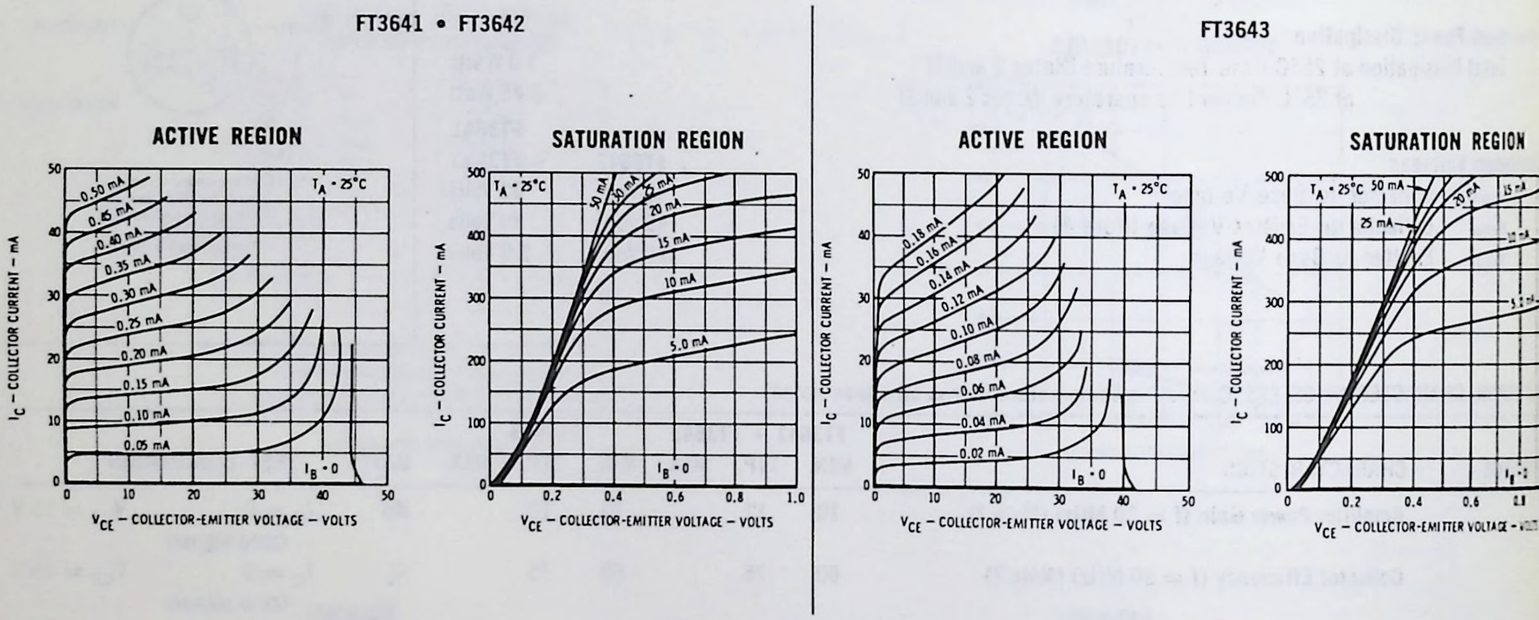
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

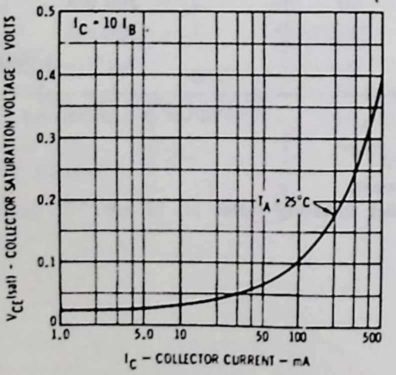
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CBO}	Collector to Base Breakdown Voltage	60			Volts	$I_C = 10\ \mu A$	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)						
	(FT3641, FT3643)	30			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
	(FT3642)	45			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
C_{obo}	Output Capacitance (f = 1.0 MHz)			8.0	pF	$I_E = 0$	$V_{CB} = 10$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.13	0.22	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(sat)}$	Pulsed Emitter Saturation Voltage (Note 5)			1.10	Volts	$I_C = 150$ mA	$I_B = 15$ mA
I_{CES}	Collector Reverse Current			0.05	μA	$V_{CE} = 50$ V	$V_{EB} = 0$
$I_{CES}(65°C)$	Collector Reverse Current			1.0	μA	$V_{CE} = 50$ V	$V_{EB} = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

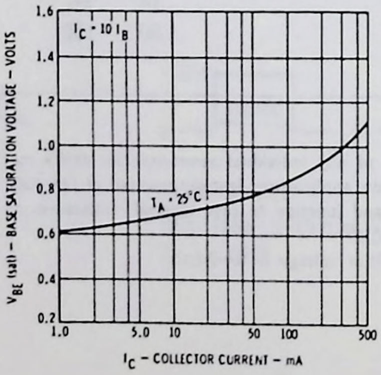
COLLECTOR CHARACTERISTICS*



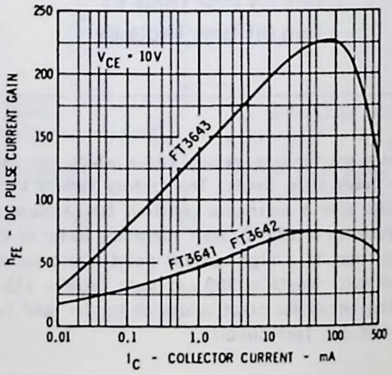
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTION CURRENT



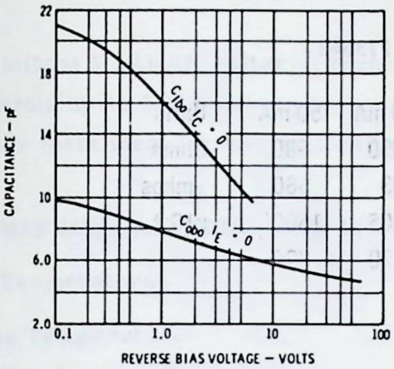
PULSE DC CURRENT GAIN VERSUS COLLECTOR CURRENT



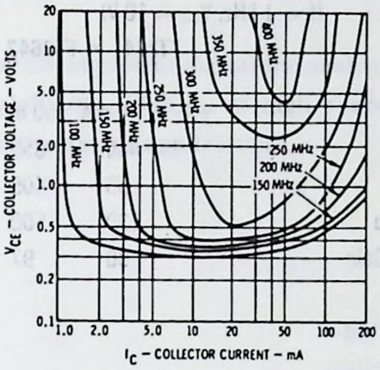
*Single Family Characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

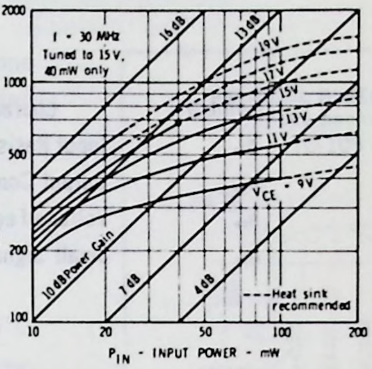
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



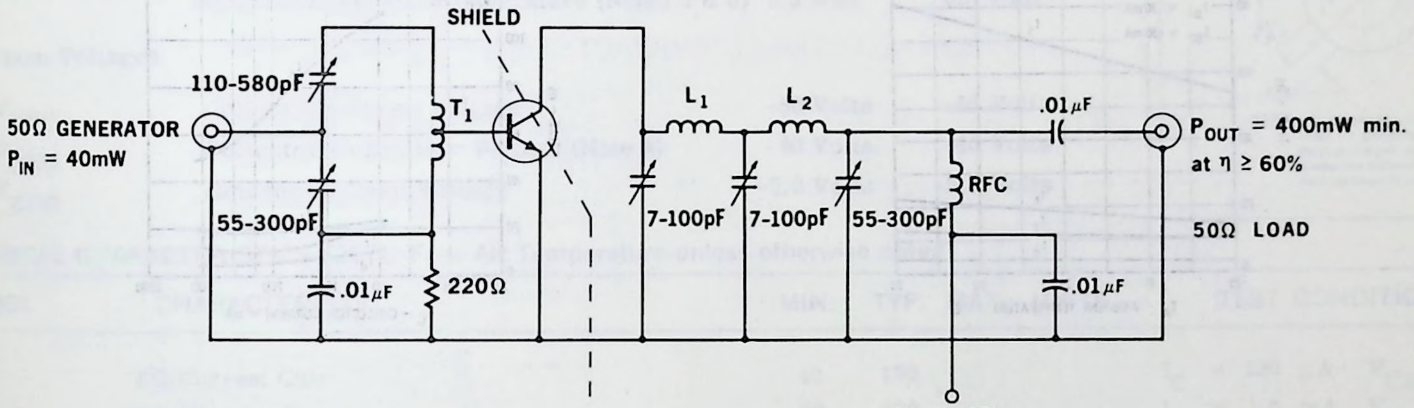
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



TYPICAL POWER IN VERSUS POWER OUT



30MHz AMPLIFIER TEST CIRCUIT


SHIELD
110-580pF
50Ω GENERATOR
P_{IN} = 40mW
T_1
55-300pF
.01μF
220Ω
L_1
L_2
7-100pF
7-100pF
55-300pF
.01μF
RFC
.01μF
P_{OUT} = 400mW min.
at η ≥ 60%
50Ω LOAD
V_{CC} = 15V

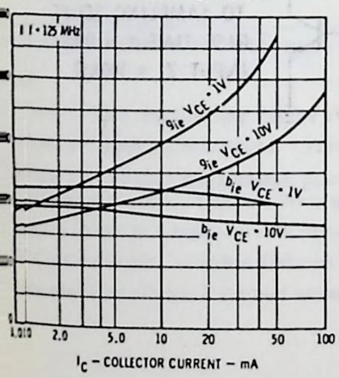
T_1 - 4 Turns no. 20 Wire, ¾" Dia. × ¼" Long, Midtapped.

L_1 and L_2 - 4 Turns no. 20 Wire, ½" Dia. × ¼" Long.

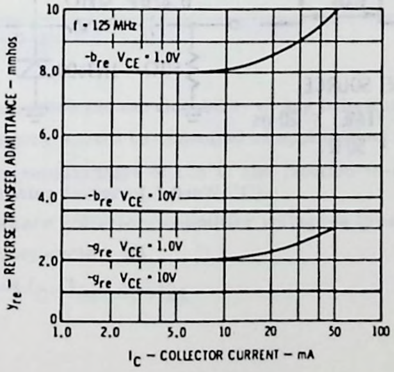
Variable Capacitors are Compression Mica.

R_G = 140Ω, R_L = 260Ω as seen by transistor.

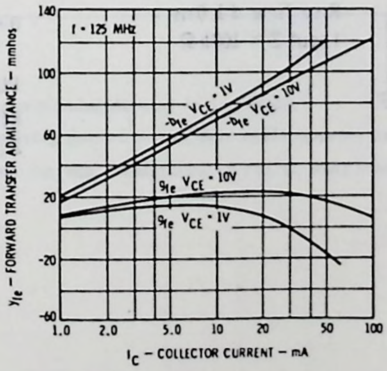
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT (OUTPUT SHORT CIRCUIT)



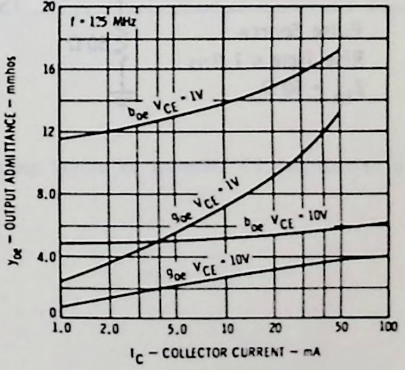
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT (INPUT SHORT CIRCUIT)



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT (OUTPUT SHORT CIRCUIT)



OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT (INPUT SHORT CIRCUIT)



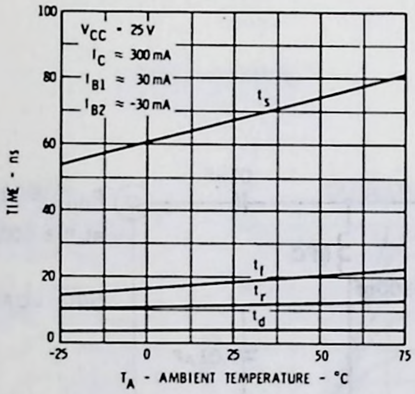
TYPICAL ELECTRICAL CHARACTERISTICS

TYPICAL SMALL SIGNAL CHARACTERISTICS

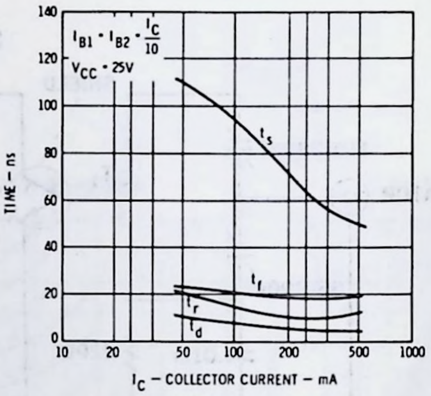
(f = 1 kHz, V_{CE} = 10 V)

		FT3641 • FT3642		FT3643		
Symbol	Characteristic	I_C = 10 mA	50 mA	10 mA	50 mA	Units
h_{ie}	Input Resistance	460	350	950	880	Ohms
h_{oe}	Output Conductance	55	405	83	660	μmhos
h_{re}	Voltage Feedback Ratio	130	500	205	1500	$x10^{-6}$
h_{fe}	Small Signal Current Gain	90	97	170	220	

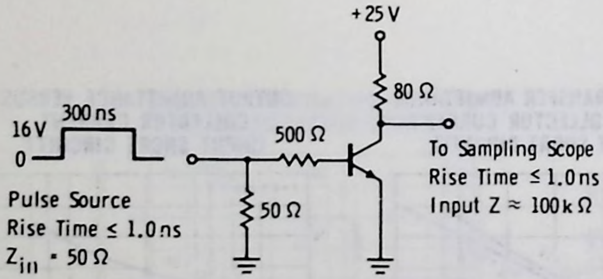
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIMES VERSUS COLLECTOR CURRENT

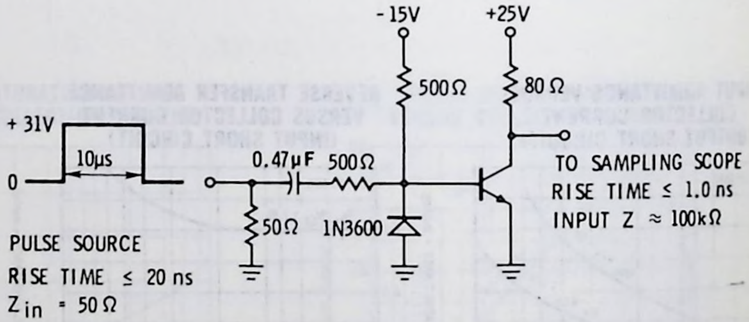


TURN-ON TEST CIRCUIT



+25 V
80 Ω
300 ns
16 V
0
500 Ω
50 Ω
To Sampling Scope
Rise Time ≤ 1.0 ns
Input Z ≈ 100 k Ω
Pulse Source
Rise Time ≤ 1.0 ns
Z_{in} = 50 Ω

TURN-OFF TEST CIRCUIT



-15V
+25V
500 Ω
80 Ω
+ 31V
10μs
0
0.47μF
500Ω
50Ω
1N3600
TO SAMPLING SCOPE
RISE TIME ≤ 1.0 ns
INPUT Z ≈ 100kΩ
PULSE SOURCE
RISE TIME ≤ 20 ns
Z_{in} = 50 Ω

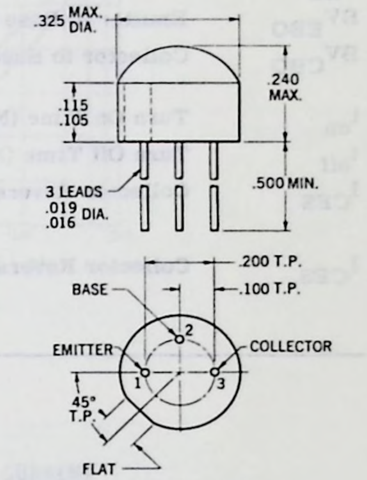
2N3644 · 2N3645

PNP HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

hese PNP silicon PLANAR epitaxial transistors are designed for digital and analog applications current levels up to 500 milliamperes. Their high beta, high f_T at high current and high V_{CEO}, make them ideal for use as line drivers and memory applications.

PHYSICAL DIMENSIONS
Epoxy package
TO-105



NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

aximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (soldering, 10 sec time limit)	+260°C Maximum

aximum Power Dissipation	2N3645	2N3644
Total Dissipation at 25°C Case Temperature (Notes 2 & 3)	0.7 Watt	0.7 Watt
at 25°C Free Air Temperature (Notes 2 & 3)	0.3 Watt	0.3 Watt

aximum Voltages

V_{CBO}	Collector to base Voltage	-60 Volts	-45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-60 Volts	-45 Volts
V_{EBO}	Emitter to Base Voltage	-5.0 Volts	-5.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
FE	DC Current Gain	40	170			I_C = 100 µA V_{CE} = -10 V
FE	DC Current Gain	80	200			I_C = 1.0 mA V_{CE} = -10 V
FE	DC Pulse Current Gain (Note 5)	100	270			I_C = 10 mA V_{CE} = -10 V
FE	DC Pulse Current Gain (Note 5)	115	160	300		I_C = 50 mA V_{CE} = -1.0 V
FE	DC Pulse Current Gain (Note 5)	100	150	300		I_C = 150 mA V_{CE} = -10 V
FE	DC Pulse Current Gain (Note 5)	20	50			I_C = 300 mA V_{CE} = -2.0 V
fe	High Frequency Current Gain (f = 100 Mc)	2.0	2.50			I_C = 20 mA V_{CE} = -20 V
obo	Common Base Output Capacitance		4.5	8.0	pf	I_E = 0 V_{CB} = -10 V
ibo	Common Base Input Capacitance		15	25	pf	I_C = 0 V_{EB} = -0.5 V

itional Electrical Characteristics on page 2

TES:

hese ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.

hese are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

hese ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 143°C/Watt (derating factor of 7.0 mW/°C); junction-to-ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C).

Rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 µsec; duty cycle = 1%.

See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
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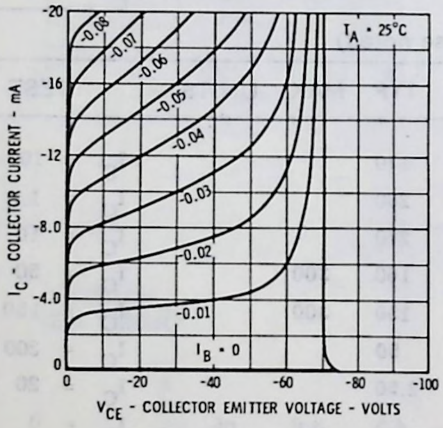
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

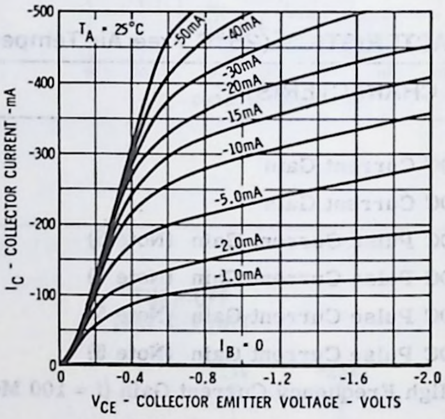
SYMBOL	CHARACTERISTIC		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, see Note 5)			-0.08	-0.25	Volts	I_C = 50 mA I_B = 2.5 mA
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, see Note 5)			-0.18	-0.4	Volts	I_C = 150 mA I_B = 15 mA
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, see Note 5)			-0.5	-1.0	Volts	I_C = 300 mA I_B = 30 mA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	2N3645 2N3644	-60 -45			Volts Volts	I_C = 10 mA I_B = 0 (pulsed)
V_{BE}(sat)	Base Saturation Voltage (Pulsed, see Note 5)			-0.9	-1.0	Volts	I_C = 50 mA I_B = 2.5 mA
V_{BE}(sat)	Base Saturation Voltage (Pulsed, see Note 5)			-1.0	-1.3	Volts	I_C = 150 mA I_B = 15 mA
V_{BE}(sat)	Base Saturation Voltage (Pulsed, see Note 5)		-0.8		-2.0	Volts	I_C = 300 mA I_B = 30 mA
BV_{EBO}	Emitter to Base Breakdown Voltage		-5.0			Volts	I_C = 0 I_E = 10 μA
BV_{CBO}	Collector to Base Breakdown Voltage	2N3645 2N3644	-60 -45			Volts Volts	I_C = 100 μA I_E = 0
t_{on}	Turn On Time (Note 6)			30	40	nsec	I_C ≈ 300 mA I_{B1} ≈ 30 mA
t_{off}	Turn Off Time (Note 6)			65	100	nsec	I_C ≈ 300 mA, I_{B1} ≈ 30 mA, I_{B2} ≈ -30m
I_{CES}	Collector Reverse Current	2N3645			35	nA	V_{CE} = -50 V V_{BE} = 0
		2N3644			35	nA	V_{CE} = -30 V V_{BE} = 0
I_{CES}	Collector Reverse Current (+65°C)	2N3645			2.0	μA	V_{CE} = -50 V V_{BE} = 0
		2N3644			2.0	μA	V_{CE} = -30 V V_{BE} = 0

TYPICAL ELECTRICAL CHARACTERISTICS

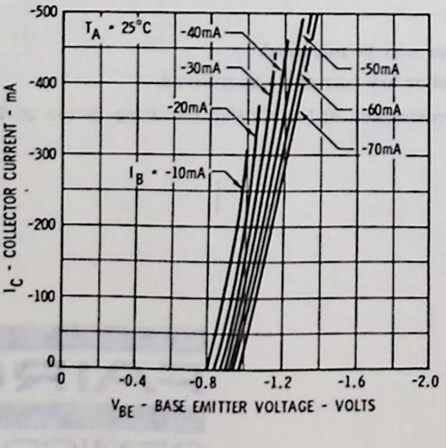
COLLECTOR CHARACTERISTICS *



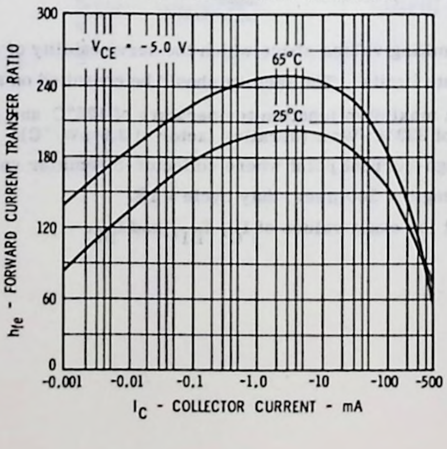
COLLECTOR CHARACTERISTICS*



BASE CHARACTERISTICS *



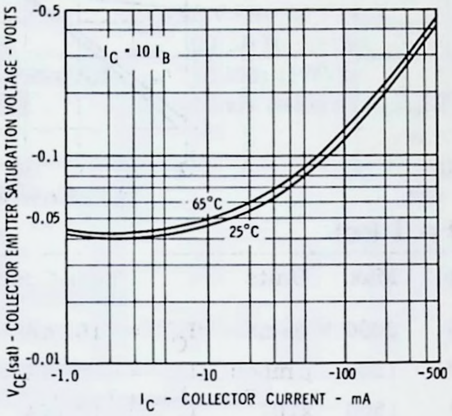
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



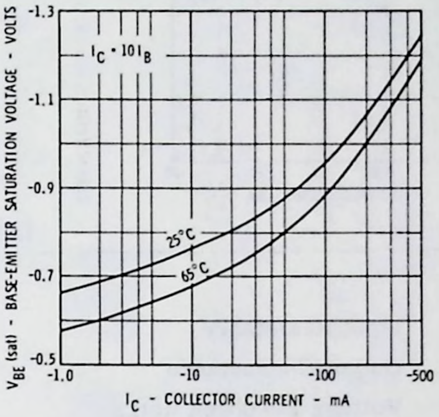
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

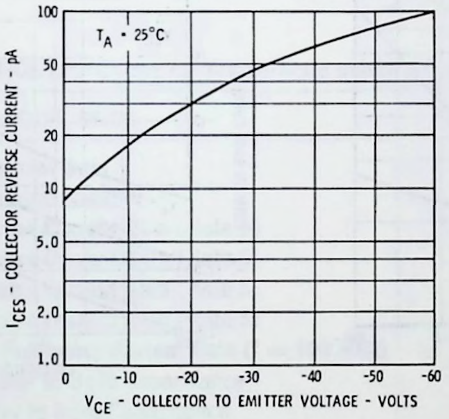
PULSED COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



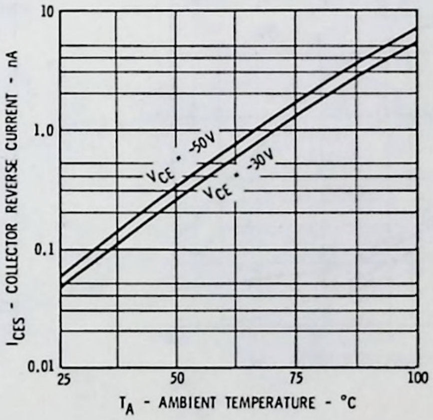
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



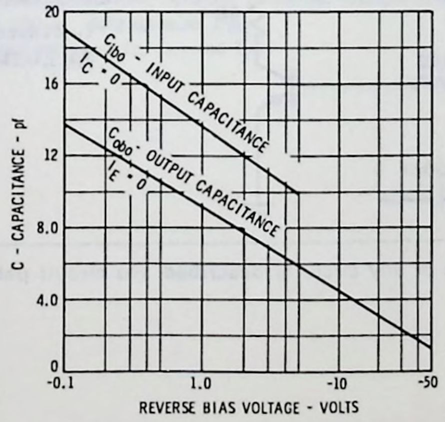
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



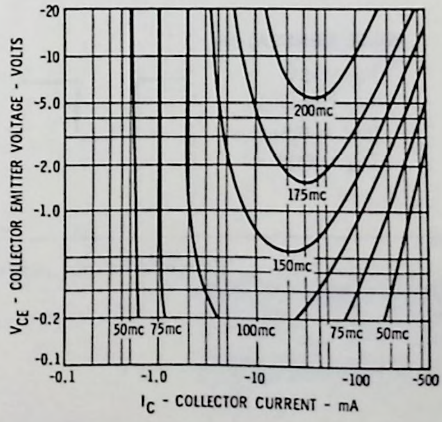
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



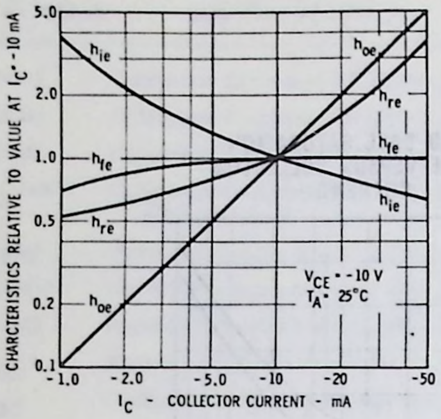
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

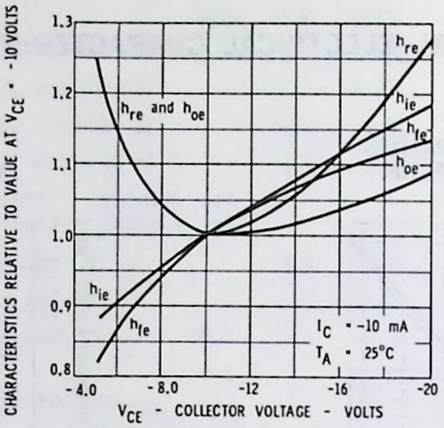


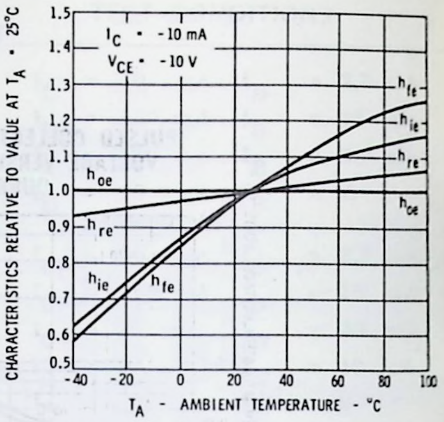
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



SMALL SIGNAL CHARACTERISTICS





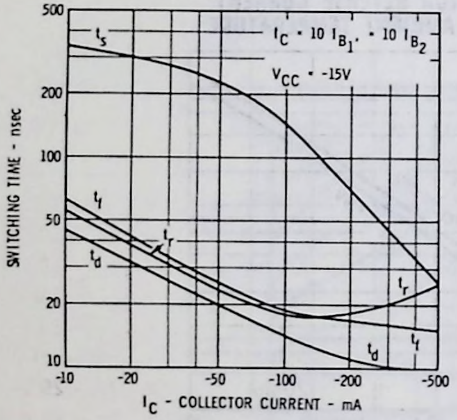


h PARAMETERS (f = 1 kc)

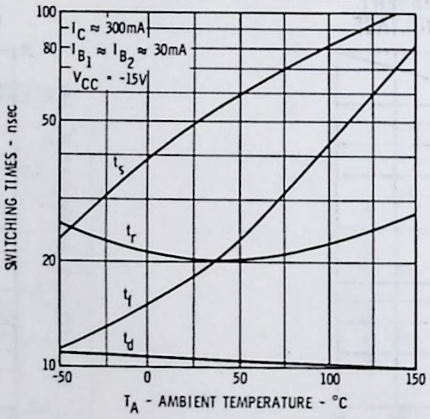
Symbol		Min.	Typ.	Max.	Units	Test Conditions	
h_{ie}	Input Resistance		480	2000	ohms	I_C = 10 mA	V_{CE} = -10 V
h_{oe}	Output Conductance		80	1200	μmhos	I_C = 10 mA	V_{CE} = -10 V
h_{re}	Voltage Feedback Ratio		162	1500	$x10^{-6}$	I_C = 10 mA	V_{CE} = -10 V
h_{fe}	Small Signal Current Gain	100				I_C = 10 mA	V_{CE} = -10 V

TYPICAL ELECTRICAL CHARACTERISTICS

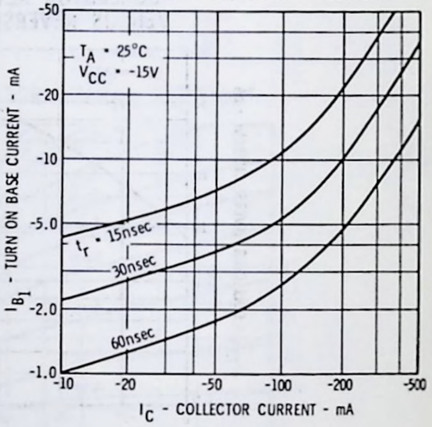
SWITCHING TIMES VERSUS COLLECTOR CURRENT



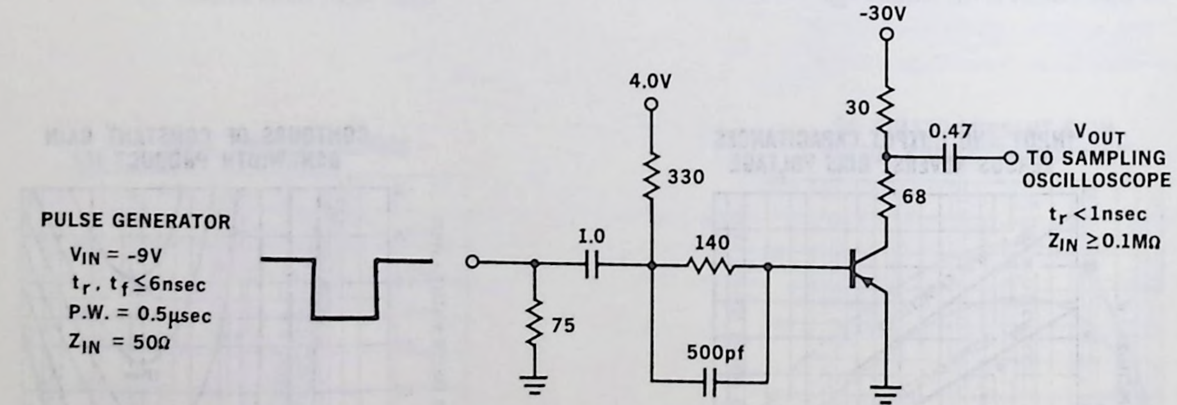
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



T_{ON} AND T_{OFF} TEST CIRCUIT


PULSE GENERATOR
V_{IN} = -9V
t_r, t_f ≤6nsec
P.W. = 0.5μsec
Z_{IN} = 50Ω
75
1.0
4.0V
330
140
500pf
-30V
30
68
0.47
V_{OUT}
TO SAMPLING
OSCILLOSCOPE
t_r <1nsec
Z_{IN} ≥0.1MΩ

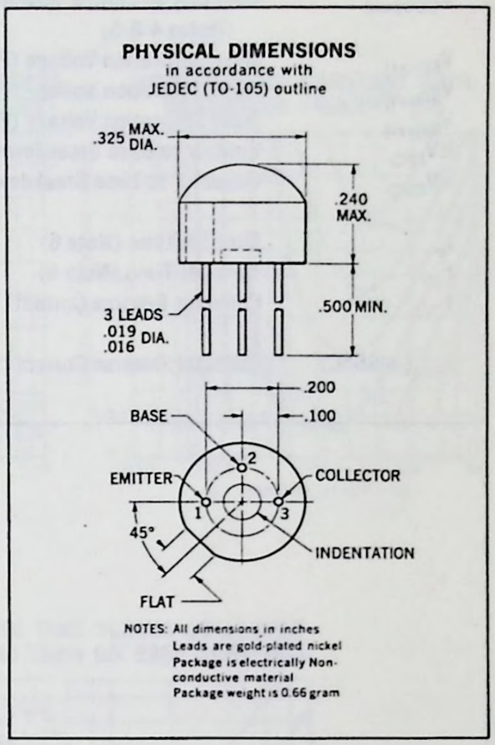
Fairchild cannot assume responsibility for use of any circuitry described. No circuit patent licenses are imp

FT3644 • FT3645

PNP HIGH-CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

HIGH POWER DISSIPATION . . . . 3.0 WATT AT 25°C CASE TEMPERATURE
HIGH VOLTAGE . . . . 45 V AND 60 V LV_{CEO}
BROAD CURRENT RANGE . . . . 100 μA TO 300 mA
HIGH GAIN BANDWIDTH PRODUCT . . . 250 MHz (TYP) f_T
OW SATURATION VOLTAGE . . . . 400 mV (MAX) AT $I_C = 150$ mA


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline

NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

OLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	**3.0 Watt**
at 25°C Free Air Temperature	0.45 Watt

Maximum Voltages

		FT3645	FT3644
V_{CBO}	Collector to Base Voltage	−60 Volts	−45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−60 Volts	−45 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts

TRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
FE	**DC Current Gain**	40	170			$I_C = 100\ \mu A$	$V_{CE} = -10$ V
FE	**DC Current Gain**	80	200			$I_C = 1.0$ mA	$V_{CE} = -10$ V
FE	**DC Pulse Current Gain** (Note 5)	100	270			$I_C = 10$ mA	$V_{CE} = -10$ V
FE	**DC Pulse Current Gain** (Note 5)	115	160	300		$I_C = 50$ mA	$V_{CE} = -1.0$ V
FE	**DC Pulse Current Gain** (Note 5)	100	150	300		$I_C = 150$ mA	$V_{CE} = -10$ V
FE	**DC Pulse Current Gain** (Note 5)	20	50			$I_C = 300$ mA	$V_{CE} = -5.0$ V
e	**High Frequency Current Gain (f = 100 MHz)**	2.0	2.5			$I_C = 20$ mA	$V_{CE} = -20$ V
cb	Collector to Base Capacitance		4.5	8.0	pF	$I_E = 0$	$V_{CB} = -10$ V
eb	Emitter to Base Capacitance		15	25	pF	$I_C = 0$	$V_{EB} = -0.5$ V

*Planar is a patented Fairchild process.

S:

ese ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
ese are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
ese ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 33°C/Watt (derating factor of 31 mW/°C); junction to ambient thermal sistance of 222°C/Watt (derating factor of 4.5 mW/°C).
ting refers to a high current point where collector to emitter voltage is lowest.
lse Conditions: length = 300 μs; duty cycle = 1%.
e : switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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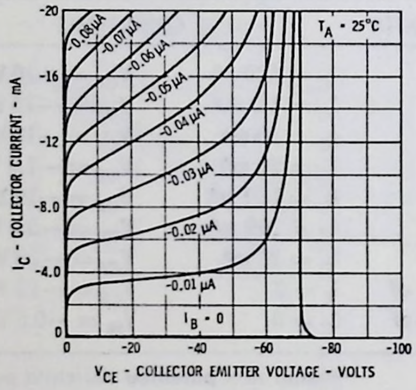
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

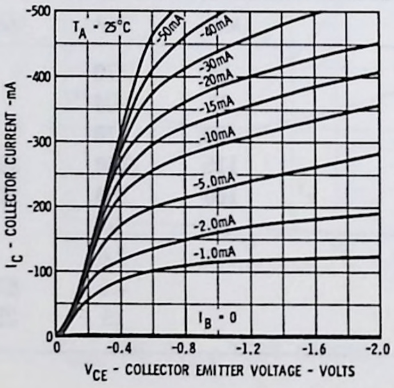
SYMBOL	CHARACTERISTICS		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CE(sat)}$	Collector Saturation Voltage (Pulsed, see Note 5)			−0.08	−0.25	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
$V_{CE(sat)}$	**Collector Saturation Voltage (Pulsed, see Note 5)**			**−0.18**	**−0.4**	**Volts**	$I_C = 150$ mA	$I_B = 15$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (Pulsed, see Note 5)			−0.5	−1.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage**	**FT3645**	**−60**			**Volts**	$I_C = 10$ mA	$I_B = 0$
	(Notes 4 & 5)	**FT3644**	**−45**			**Volts**	(pulsed)	
$V_{BE(sat)}$	Base Saturation Voltage (Pulsed, see Note 5)			−0.9	−1.0	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Pulsed, see Note 5)			−1.0	−1.3	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Pulsed, see Note 5)		−0.8		−2.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
BV_{EBO}	Emitter to Base Breakdown Voltage		−5.0			Volts	$I_C = 0$	$I_E = 10\ \mu$A
BV_{CBO}	Collector to Base Breakdown Voltage	FT3645	−60			Volts	$I_C = 100\ \mu$A	$I_E = 0$
		FT3644	−45			Volts		
t_{on}	Turn On Time (Note 6)			30	40	ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	Turn Off Time (Note 6)			65	100	ns	$I_C \approx 300$ mA, $I_{B1} \approx 30$ mA, $I_{B2} \approx -30$ mA	
I_{CES}	Collector Reverse Current	FT3645			35	nA	$V_{CE} = -50$ V	$V_{BE} = 0$
		FT3644			35	nA	$V_{CE} = -30$ V	$V_{BE} = 0$
$I_{CES}(+65°C)$	Collector Reverse Current	FT3645			2.0	μA	$V_{CE} = -50$ V	$V_{BE} = 0$
		FT3644			2.0	μA	$V_{CE} = -30$ V	$V_{BE} = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

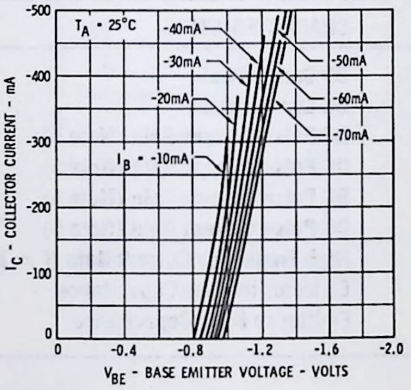
COLLECTOR CHARACTERISTICS*



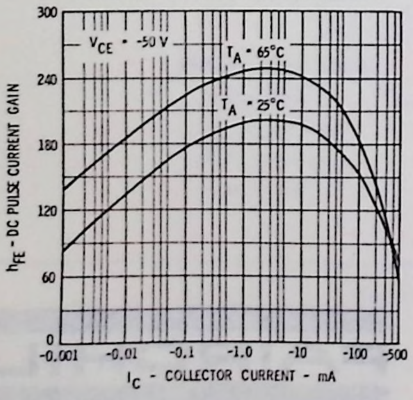
COLLECTOR CHARACTERISTICS*



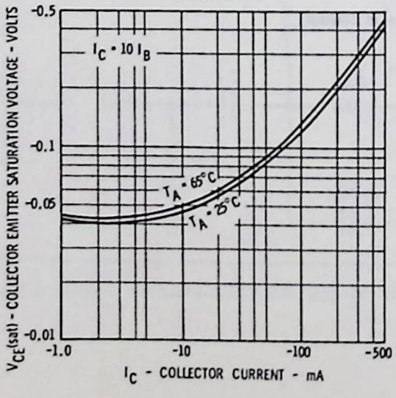
BASE CHARACTERISTICS*



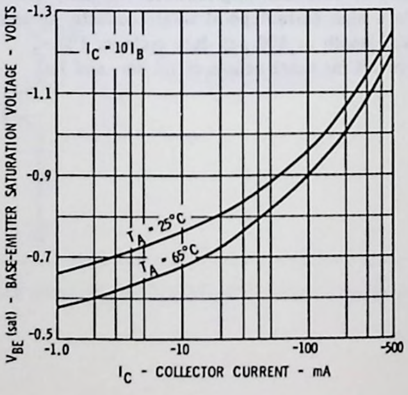
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



PULSED COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



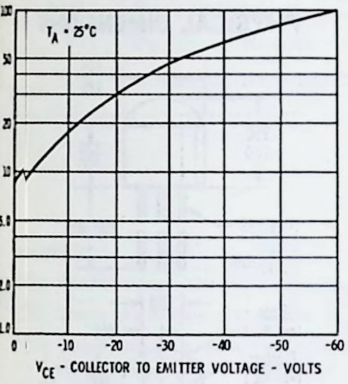
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



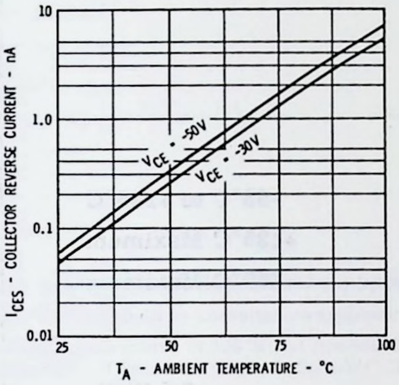
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

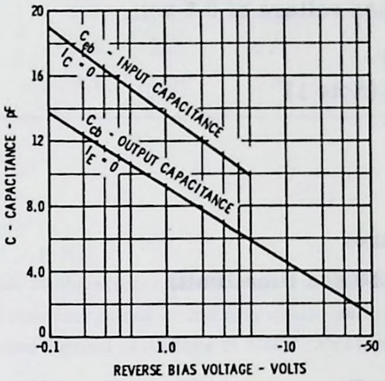
COLLECTOR REVERSE CURRENT VVERSUS REVERSE BIAS VOLTAGE



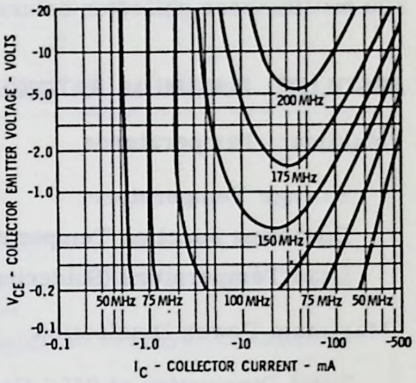
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPEATURE



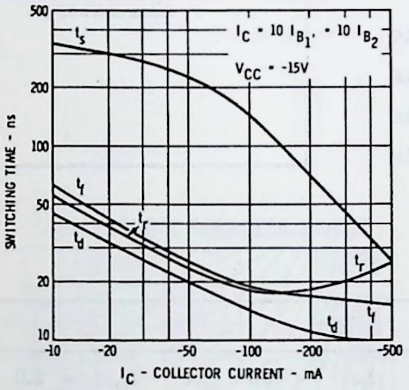
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



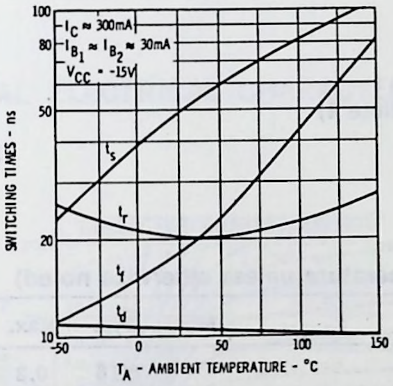
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



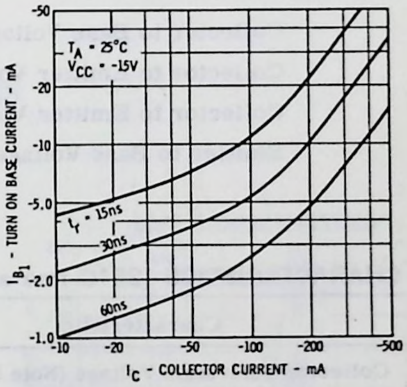
SWITCHING TIMES VERSUS COLLECTOR CURRENT



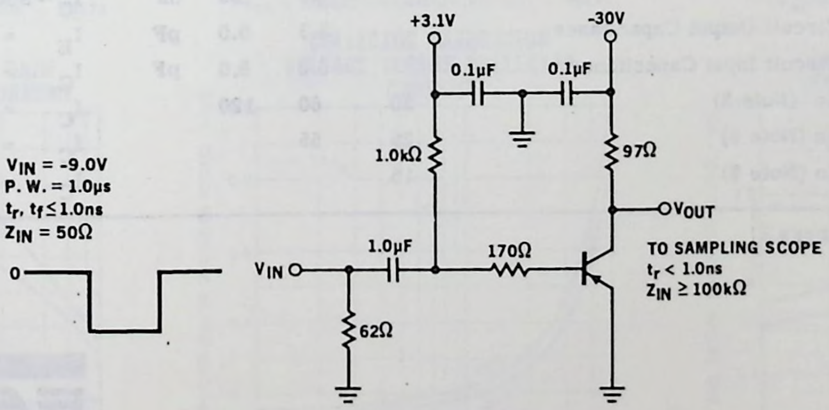
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



t_{on} AND t_{off} TEST CIRCUIT


+3.1V
-30V
0.1μF
0.1μF
1.0kΩ
97Ω
V_{IN} = -9.0V
P. W. = 1.0μs
t_r, t_f ≤ 1.0ns
Z_{IN} = 50Ω
0
V_{OUT}
1.0μF
170Ω
V_{IN}
TO SAMPLING SCOPE
t_r < 1.0ns
Z_{IN} ≥ 100kΩ
62Ω

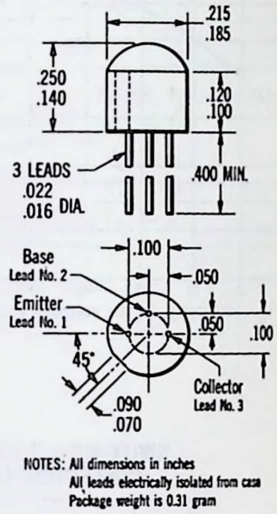
2N3646

FAIRCHILD NPN DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

HIGH SPEED SATURATED SWITCH

The 2N3646 is an NPN silicon PLANAR epitaxial transistor designed for memory applications to 500 milliamperes. It features the unique combination of 350 MHz f_T minimum with a guaranteed 300 milliampere collector saturation voltage of 0.5 volt.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering 10 sec time limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.16	0.2	Volts	I_C = 30 mA I_B = 3.0 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.18	0.28	Volts	I_C = 100 mA I_B = 10 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5) (T_A = +65°C)		0.18	0.3	Volts	I_C = 30 mA I_B = 3.0 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.39	0.5	Volts	I_C = 300 mA I_B = 30 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.5	5.5			I_C = 30 mA V_{CE} = 10 V
τ_s	Charge Storage Time Constant (Note 6)		8.0	18	ns	$I_C = I_{B1} \approx$ 10 mA $I_{B2} \approx$ -10 mA
t_{on}	Turn On Time (Note 6)		9.0	18	ns	$I_C \approx$ 300 mA $I_{B1} \approx$ 30 mA
t_{off}	Turn Off Time (Note 6)		15	28	ns	$I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA, $I_{B2} \approx$ -30
C_{obo}	Common Base Open Circuit Output Capacitance		3.3	5.0	pF	I_E = 0 V_{CB} = 5.0 V
C_{ibo}	Common Base Open Circuit Input Capacitance		6.6	8.0	pF	I_C = 0 V_{EB} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60	120		I_C = 30 mA V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55			I_C = 100 mA V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	15				I_C = 300 mA V_{CE} = 1.0 V

Additional Electrical Characteristics on page 2
Notes on page 2

* Planar is a patented Fairchild proc

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ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS			
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	I_C	= 100 μA	I_E	= 0
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	I_C	= 100 μA	V_{EB}	= 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			Volts	I_C	= 10 mA	I_B	= 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	I_E	= 100 μA	I_C	= 0
V_{BE}(sat)	Base Saturation Voltage (Note 5)	0.75	0.82	0.95	Volts	I_C	= 30 mA	I_B	= 3.0 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.97	1.2	Volts	I_C	= 100 mA	I_B	= 10 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.3	1.7	Volts	I_C	= 300 mA	I_B	= 30 mA
$_{CES}$	Collector Reverse Current		0.04	0.5	μA	V_{CE}	= 20 V	V_{EB}	= 0
$_{CES}$(65°C)	Collector Reverse Current		0.5	3.0	μA	V_{CE}	= 20 V	V_{EB}	= 0

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C). Junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

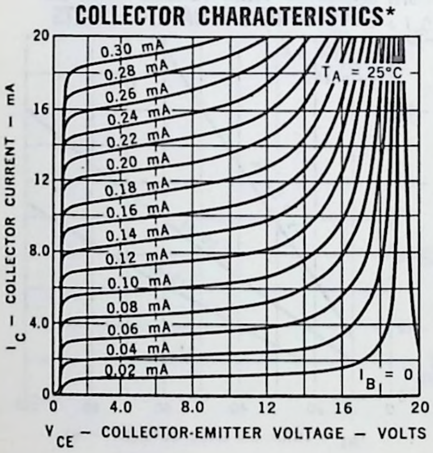
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

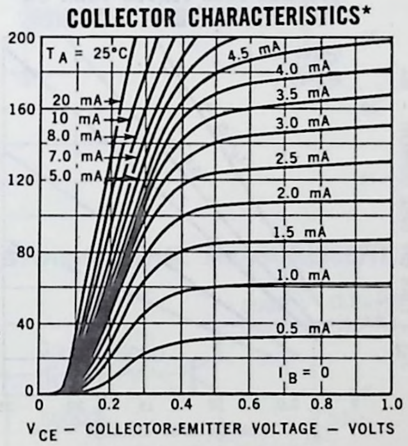
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

TYPICAL ELECTRICAL CHARACTERISTICS

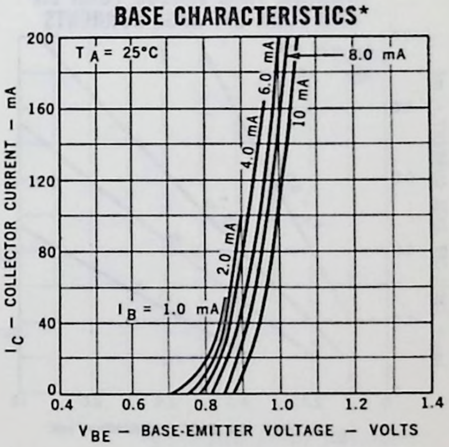
COLLECTOR CHARACTERISTICS*



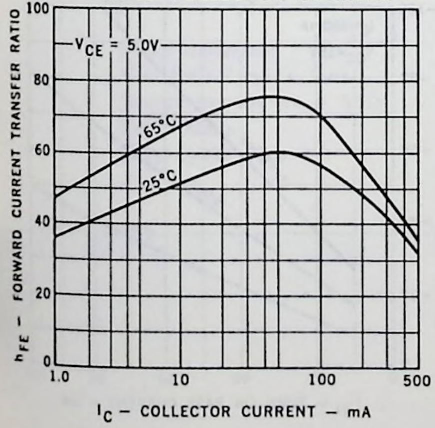
COLLECTOR CHARACTERISTICS*



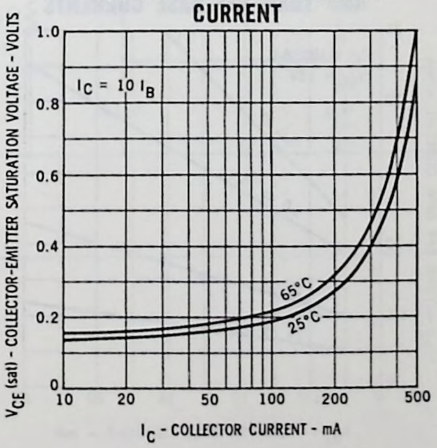
BASE CHARACTERISTICS*



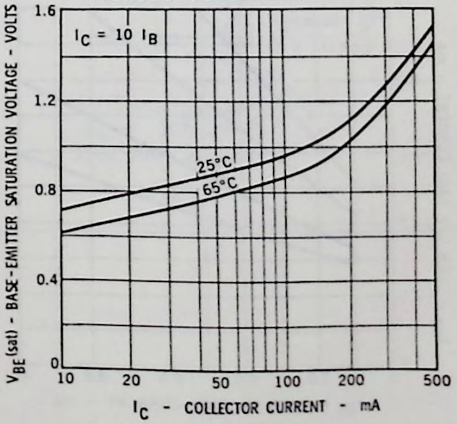
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



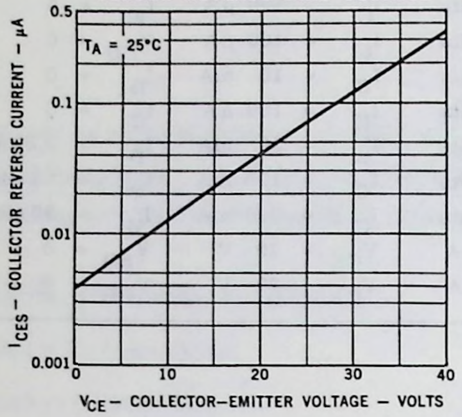
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



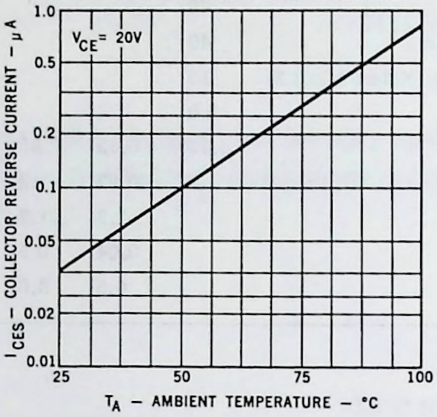
ngle family characteristics on Transistor Curve Tracer

TYPICAL ELECTRICAL CHARACTERISTICS

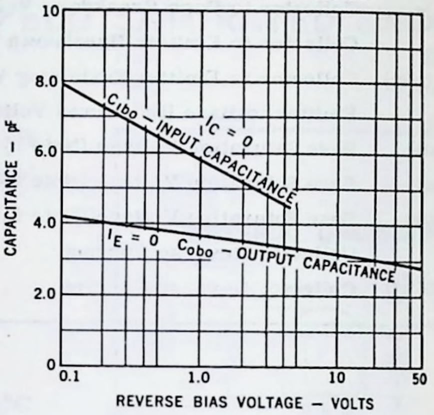
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



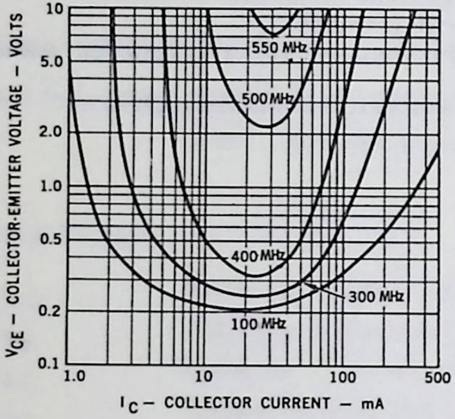
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



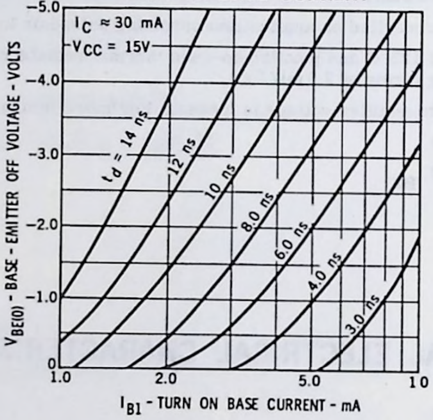
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



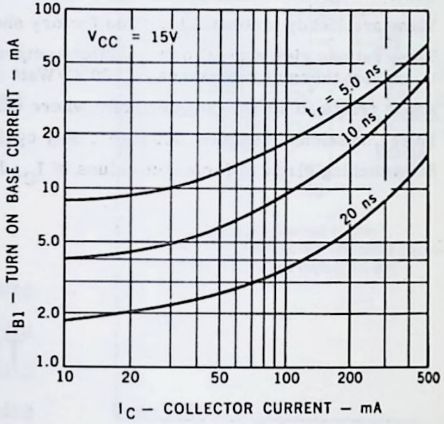
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (fT)



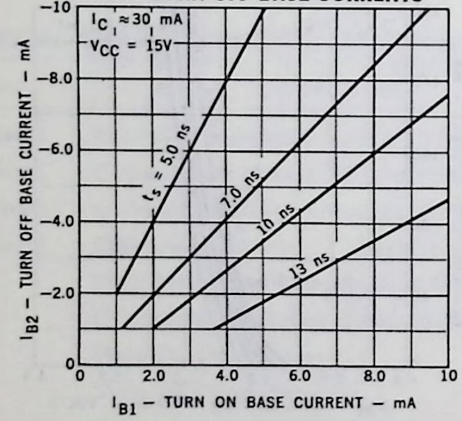
DELAY TIME VERSUS BASE EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



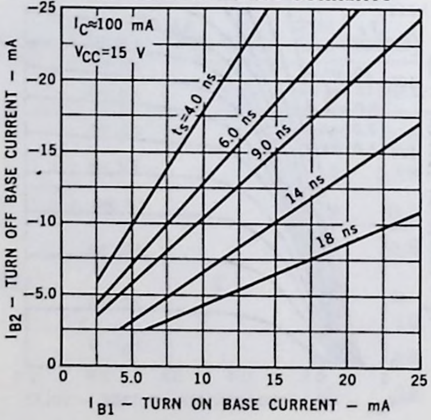
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



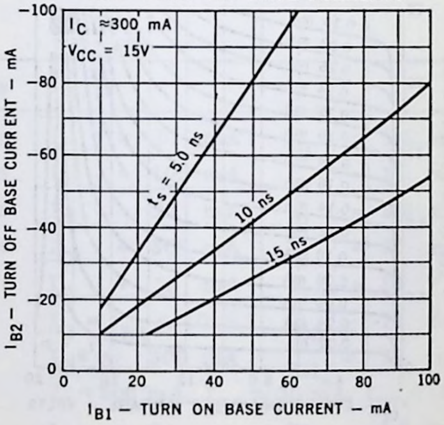
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



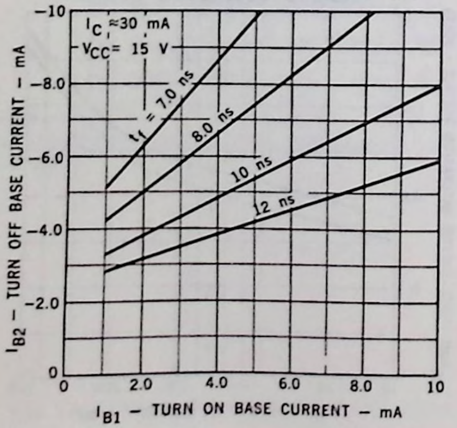
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



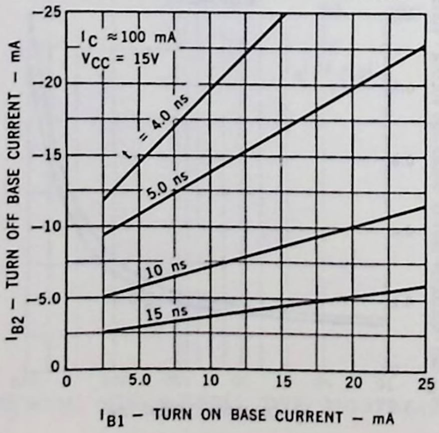
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



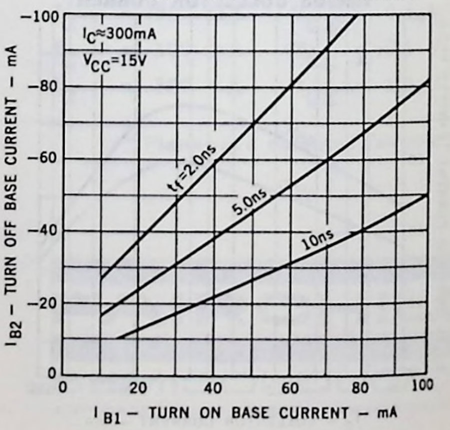
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

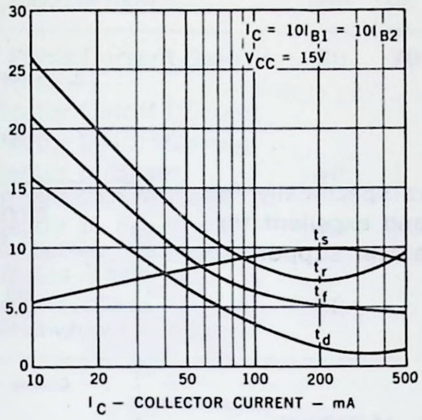


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

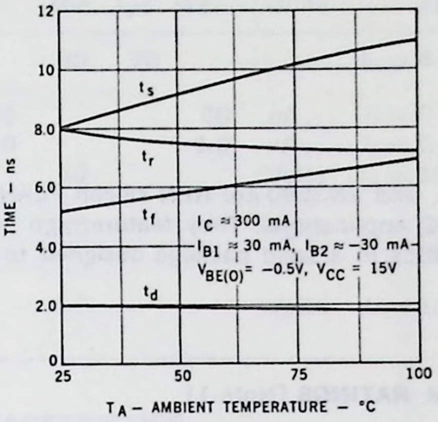


TYPICAL ELECTRICAL CHARACTERISTICS

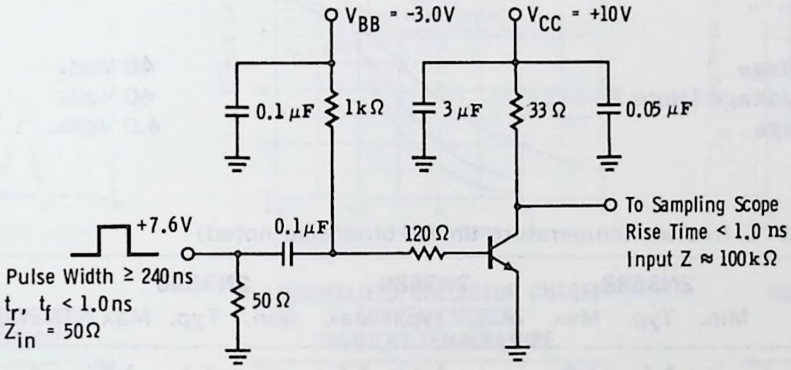
SWITCHING TIMES VERSUS COLLECTOR CURRENT



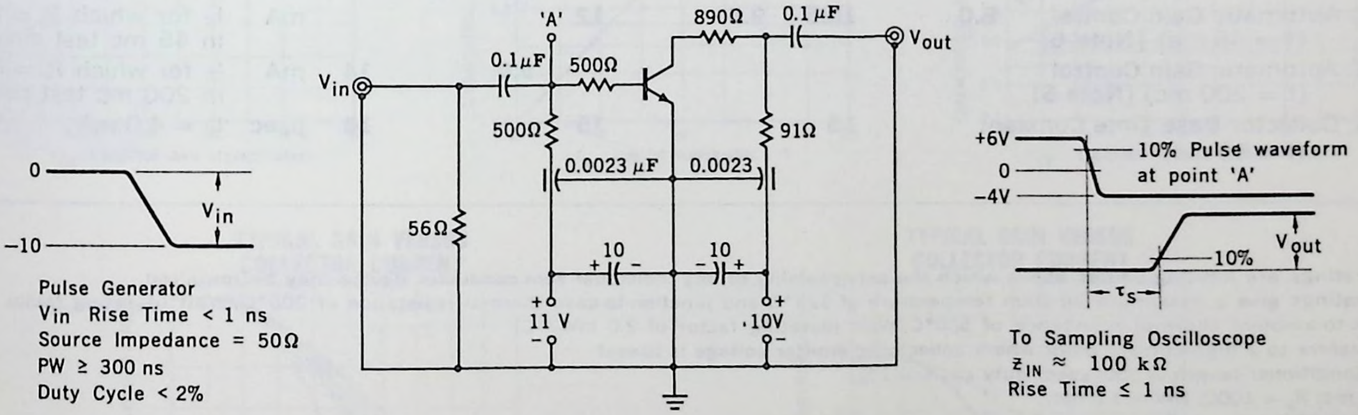
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



T_{ON} and T_{OFF} TEST CIRCUIT


$V_{BB} = -3.0V$
$V_{CC} = +10V$
0.1 μF
1 kΩ
3 μF
33 Ω
0.05 μF
To Sampling Scope
Rise Time < 1.0 ns
Input Z ≈ 100 kΩ
+7.6V
0.1 μF
120 Ω
50 Ω
Pulse Width ≥ 240 ns
t_r, t_f < 1.0 ns
Z_{in} = 50Ω

CHARGE STORAGE TIME MEASUREMENT CIRCUIT


'A'
890Ω
0.1 μF
V_{out}
0.1 μF
500Ω
V_{in}
500Ω
91Ω
0.0023 μF
0.0023
56Ω
10
10
+ 11 V –
+ 10V –
0
–10
V_{in}
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2%
+6V
0
–4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_S
To Sampling Oscilloscope
Z_{IN} ≈ 100 kΩ
Rise Time ≤ 1 ns

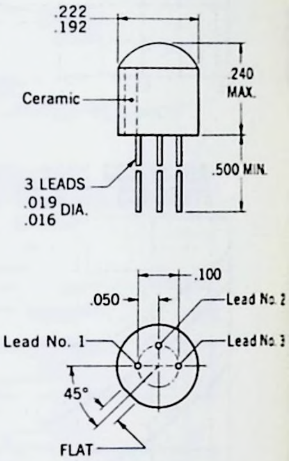
2N3688 · 2N3689 · 2N3690

NPN RF-AGC AMPLIFIERS

SILICON PLANAR TRANSISTORS

The 2N3688, 2N3689, and 2N3690 are NPN silicon PLANAR transistors designed specifically for commercial RF-IF-AGC applications. They feature high power gain, low noise, and excellent forward AGC characteristics in a solid package designed to give maximum mechanical support to the transistor chip.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES All dimensions in inches
All leads electrically isolated from case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Operating Junction Temperature	**125°C** Maximum
Storage Temperature	**−55°C** to **+125°C**
Soldering Temperature	**260°C** Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Note 2]	**0.5** Watt
at 65°C Case Temperature [Note 2]	**0.3** Watt
at 25°C Ambient Temperature [Note 2]	**0.2** Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	**40** Volts
V_{CEO}	Collector to Emitter Voltage [Note 3]	**40** Volts
V_{EBO}	Emitter to Base Voltage	**4.0** Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

		2N3688			**2N3689**			**2N3690**					
Symbol	Characteristics	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	TEST CONDITIONS	
C_{ob}	Output Capacitance		1.1	1.6		1.1	1.6		1.1	1.6	pf	$I_E = 0$	$V_{CB} = 10$ V
C_{cb}	Guarded Output Capacitance		0.8			0.8			0.8		pf	$I_E = 0$	$V_{CB} = 10$ V
NF	Noise Figure [Note 5]								4.0	5.5	db	$I_C = 4.0$ mA	$V_{CE} = 10$ V
h_{fe}	High Frequency Current Gain (f = 100 mc)	4.0	6.0		4.0	6.0		4.0	6.0			$I_C = 4.0$ mA	$V_{CE} = 10$ V
PG_1	Power Gain (f = 45 mc)	29	33		29	33					db	$I_C = 4.0$ mA	$V_{CE} = 10$ V
PG_2	Power Gain (f = 200 mc)							15	18		db	$I_C = 4.0$ mA	$V_{CE} = 10$ V
AGC_1	Automatic Gain Control (f = 45 mc) [Note 6]	8.0		10.5	9.5		12				mA	I_C for which $P_G = P_{G1} - 30$ db in 45 mc test circuit	
AGC_2	Automatic Gain Control (f = 200 mc) [Note 6]							9.0		14	mA	I_C for which $P_G = P_{G2} - 30$ db in 200 mc test circuit	
$r_b'C_c$	Collector-Base Time Constant (f = 80 mc)			15			15			15	psec	$I_C = 4.0$ mA	$V_{CE} = 10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/ junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(5) f = 200 mc; $R_S = 100\Omega$; BW = 1.0 mc.

(6) Additional AGC information on page 2.

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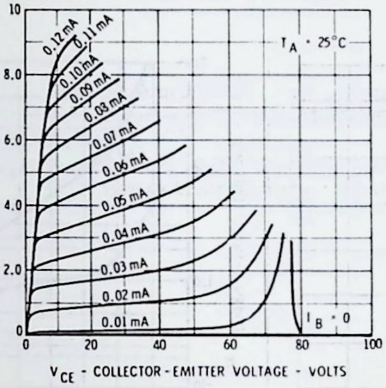
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

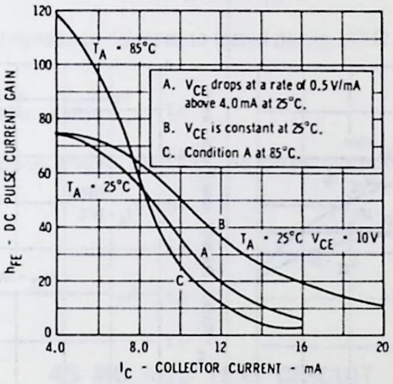
Symbol	Characteristics	2N3688 Min.	2N3688 Typ.	2N3688 Max.	2N3689 Min.	2N3689 Typ.	2N3689 Max.	2N3690 Min.	2N3690 Typ.	2N3690 Max.	Units	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 4]	30	70		30	70		30	70			$I_C = 4.0$ mA $V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current			50			50			50	nA	$I_E = 0$ $V_{CB} = 20$ V
I_{CBO} (65°C)	Collector Cutoff Current			5.0			5.0			5.0	μA	$I_E = 0$ $V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40			40			40			Volts	$I_C = 100$ μA $I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 3 and 4]	40			40			40			Volts	$I_C = 3.0$ mA $I_B = 0$ (Pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			4.0			Volts	$I_E = 100$ μA $I_C = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

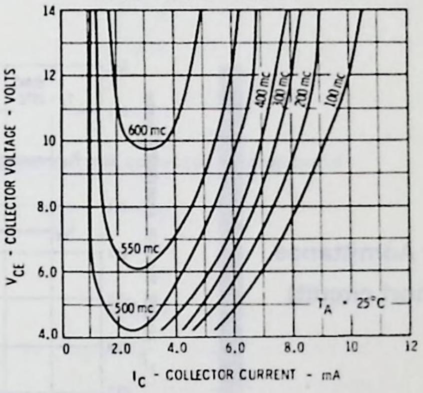
COLLECTOR CHARACTERISTICS*



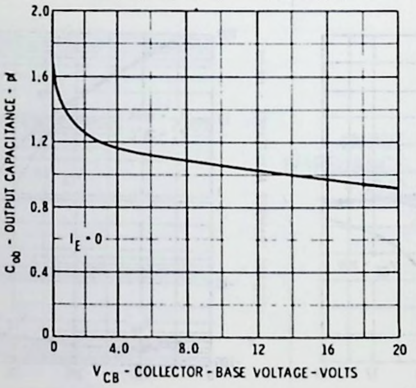
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



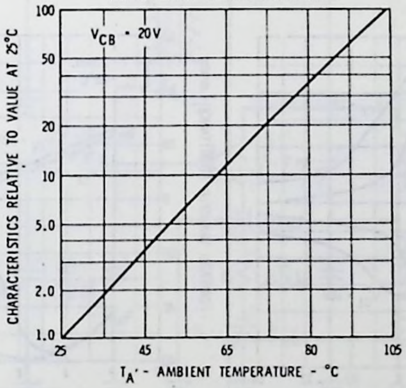
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



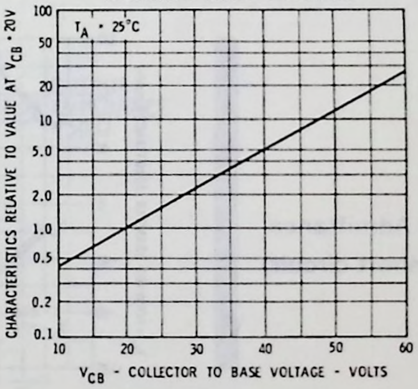
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



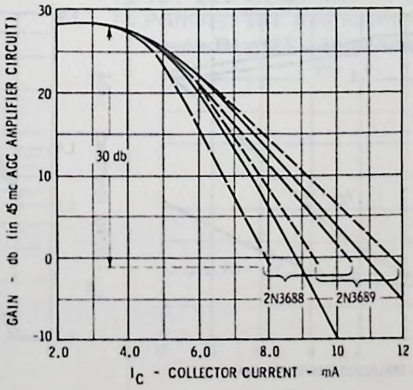
NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



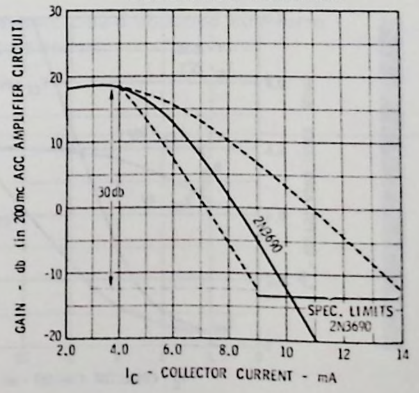
NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



TYPICAL GAIN VERSUS COLLECTOR CURRENT



TYPICAL GAIN VERSUS COLLECTOR CURRENT



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*Single family characteristics on Transistor Curve Tracer

TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

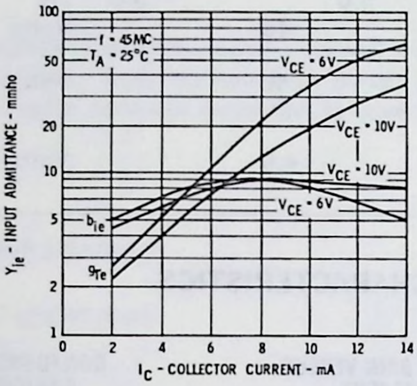
2N3688 • 2N3689
45 mc
vs. COLLECTOR CURRENT

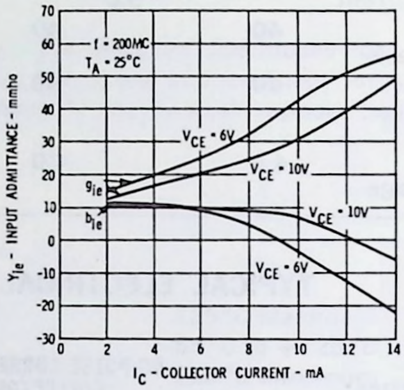
2N3690
200 mc
vs. COLLECTOR CURRENT

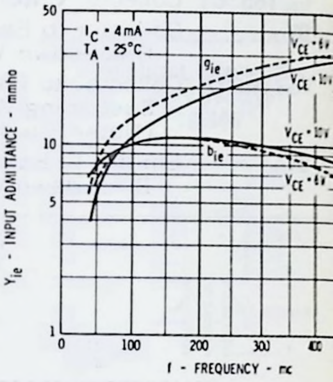
2N3688 • 2N3689 • 2N3
vs. FREQUENC

y_{ie}

Input Admittance (output short circuit)

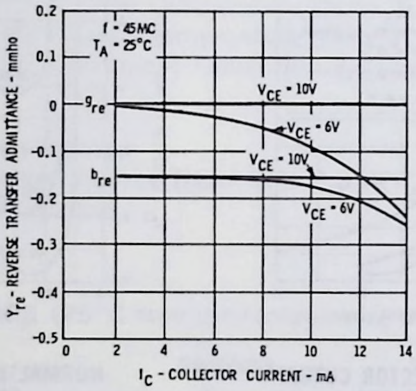


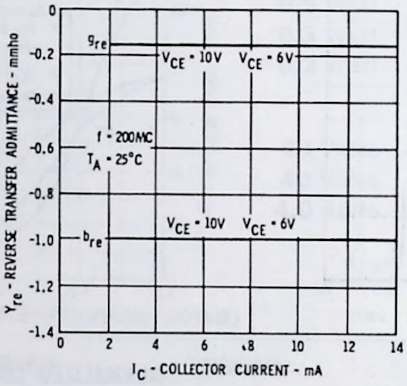


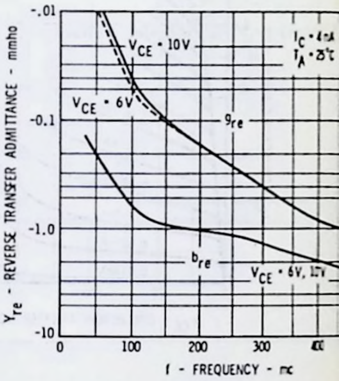


y_{re}

Reverse Transfer Admittance (input short circuit)

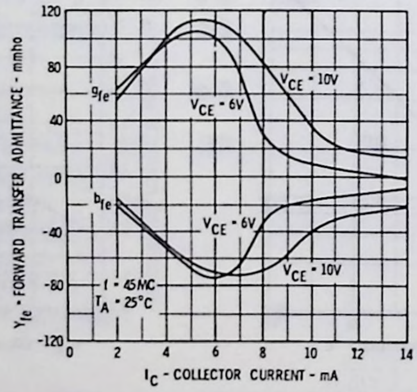


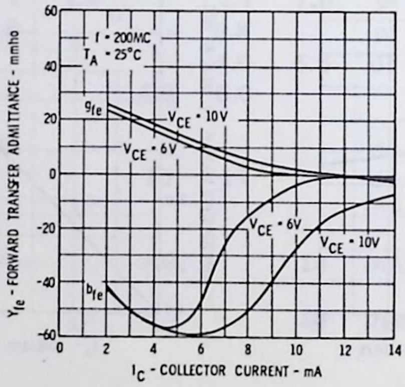


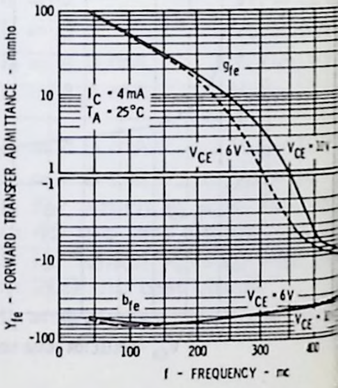


y_{fe}

Forward Transfer Admittance (output short circuit)

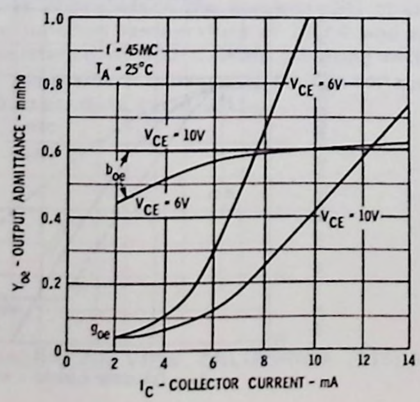


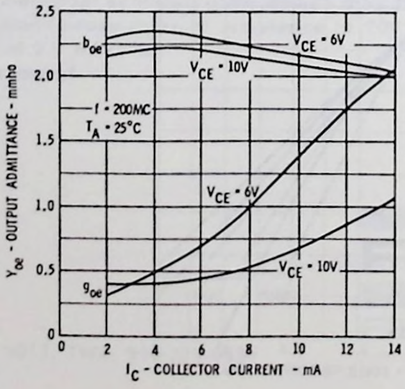


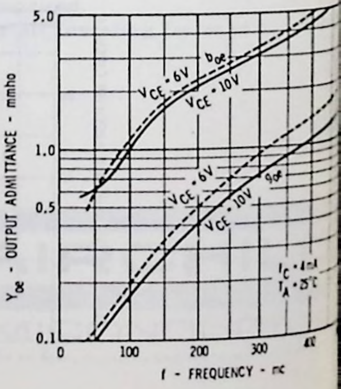


y_{oe}

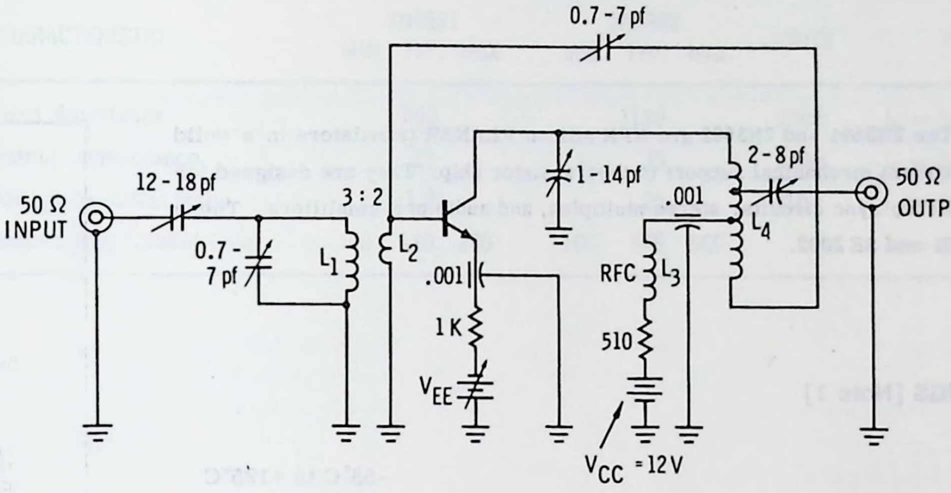
Output Admittance (input short circuit)







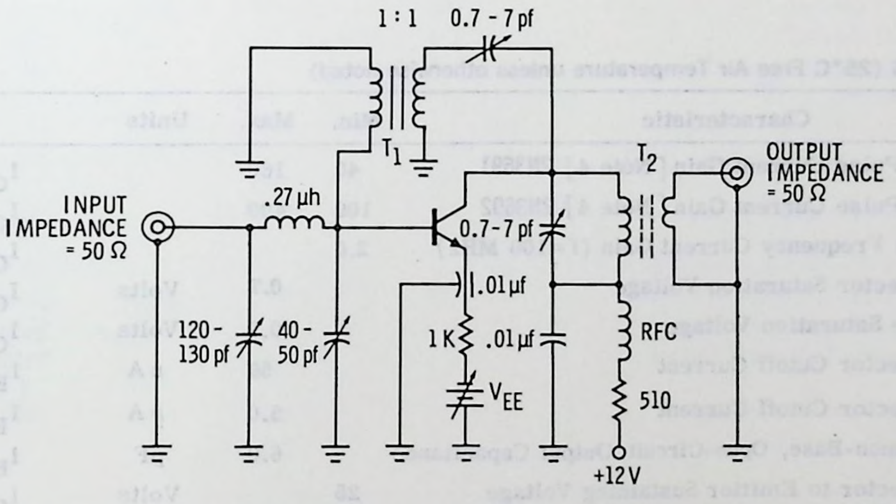
200 MC AGC TEST CIRCUIT


0.7 - 7 pf
50 Ω
INPUT
12 - 18 pf
3 : 2
0.7 -
7 pf
L1
L2
1 - 14 pf
2 - 8 pf
.001
50 Ω
OUTPUT
L4
.001
RFC
L3
1 K
510
VEE
VCC = 12 V

Input impedance referred to transistor is 100 Ω.

L_1 = 3 turns #18 wire on ¼" ceramic core
L_2 = 2 turns #18 wire interwound at cold end with L_1
L_3 = RFC
L_4 = 4 turns .076" diam. silver tubing space wound (⅜" I.D., no core). Output tap at ½ turn from collector end ground tap at 2 turns from collector end

45 MC AGC TEST CIRCUIT


1 : 1
0.7 - 7 pf
T1
T2
OUTPUT
IMPEDANCE
= 50 Ω
INPUT
IMPEDANCE
= 50 Ω
.27 μh
0.7 - 7 pf
.01 μf
120 -
130 pf
40 -
50 pf
1 K
.01 μf
RFC
VEE
510
+12V

T_1: 12T #32 bifilar wire on Q2 toroid ($\mu = 115$)
T_2: Primary: 10T #36 enameled wire wound on micrometals L-52-6 shielded coil form
Secondary: 2T #36 enameled wire tightly coupled to primary

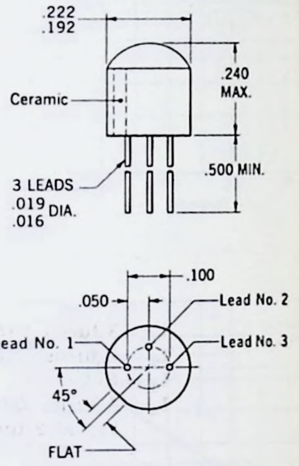
2N3691 · 2N3692

NPN GENERAL PURPOSE

DIFFUSED SILICON PLANAR* TRANSISTORS

GENERAL DESCRIPTION - The 2N3691 and 2N3692 are NPN silicon PLANAR* transistors in a solid package designed to give maximum mechanical support to the transistor chip. They are designed for use in audio and video amplifiers, sync circuits, stereo multiplex, and audio pre-amplifiers. These devices are similar to SE 2001 and SE 2002.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	125°C Maximum
Soldering Temperature (10 sec time limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	[Note 2]	0.5 Watt
at 65°C Case Temperature	[Note 2]	0.3 Watt
at 25°C Ambient Temperature	[Note 2]	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	35 Volts
V_{CEO}	Collector to Emitter Voltage [Note 3]	25 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain [Note 4] 2N3691	40	160		I_C = 10 mA V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain [Note 4] 2N3692	100	400		I_C = 10 mA V_{CE} = 1.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0			I_C = 10 mA V_{CE} = 15 V
V_{CE}(sat)	Collector Saturation Voltage		0.7	Volts	I_C = 10 mA I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage		0.9	Volts	I_C = 10 mA I_B = 1.0 mA
I_{CBO}	Collector Cutoff Current		50	nA	I_E = 0 V_{CB} = 30 V
I_{CBO} (65°C)	Collector Cutoff Current		5.0	μA	I_E = 0 V_{CB} = 30 V
C_{obo}	Common-Base, Open-Circuit Output Capacitance		6.0	pF	I_E = 0 V_{CB} = 10 V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage [Notes 3 and 4]	25		Volts	I_C = 10 mA (pulsed) I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	35		Volts	I_C = 100 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		Volts	I_C = 0 I_E = 10 μA

* Planar is a patented Fairchild proce

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SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

SYMBOL	CHARACTERISTIC	2N3691			2N3692			UNITS	TEST CONDITIONS
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
h_{ie}	Input Resistance		900			1130		Ohms	I_C = 5.0 mA V_{CE} = 10 V
h_{oe}	Output Conductance		25			35		μmho	I_C = 5.0 mA V_{CE} = 10 V
h_{re}	Voltage Feedback Ratio		1.2			1.25		$x10^{-4}$	I_C = 5.0 mA V_{CE} = 10 V
h_{fe}	Small Signal Current Gain	40	110	200	100	145	560		I_C = 5.0 mA V_{CE} = 10 V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

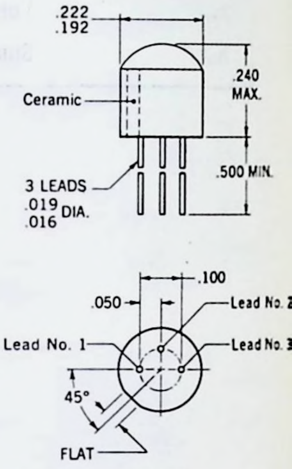
(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

2N3693 · 2N3694
NPN AM/FM TYPE
DIFFUSED SILICON PLANAR TRANSISTORS

GENERAL DESCRIPTION The 2N3693 and 2N3694 are NPN silicon PLANAR transistors designed specifically for A.M.-F.M. receiver applications. They feature high power gain, high beta, and low collector cutoff current in a solid package designed to give maximum mechanical support to the transistor chip. These devices are similar to SE1001 and SE1002.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Leads are nickel
Package weight is 0.31 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Operating Junction Temperature	125°C Maximum
Storage Temperature	−55°C to +125°C
Soldering Temperature (10 sec time limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Note 2]	0.5 Watt
at 65°C Case Temperature [Note 2]	0.3 Watt
at 25°C Ambient Temperature [Note 2]	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	45 Volts
V_{CEO}	Collector to Emitter Voltage [Note 3]	45 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N3693 Min.	Typ.	Max.	2N3694 Min.	Typ.	Max.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 4]	40		160	100		400		$I_C = 10$ mA $V_{CE} = 10$V
I_{CBO}	Collector Cutoff Current			50			50	nA	$I_E = 0$ $V_{CB} = 35$V
I_{CBO} (65°C)	Collector Cutoff Current			5.0			5.0	μA	$I_E = 0$ $V_{CB} = 35$V
C_{obo}	Common Base, Open Circuit, Output Capacitance			3.5			3.5	pf	$I_E = 0$ $V_{CB} = 10$V
NF	Spot Noise Figure [Note 5]		4.0			4.0		db	$I_C = 3.0$ mA $V_{CE} = 10$V
A_{pg}	Available Power Gain (neutralized) (f = 10.7 mc)		32			32		db	$I_C = 7.0$ mA $V_{CE} = 10$V
A_{pg}	Available Power Gain (neutralized) (f = 455 kc)		55			55		db	$I_C = 3.0$ mA $V_{CE} = 10$V
G_C	Conversion Gain (f = 108 mc to 10.7 mc)		20			20		db	$I_C = 7.0$ mA $V_{CE} = 10$V
$r_b'C_c$	Collector-Base Time Constant (f= 80 mc)			55			55	psec	$I_C = 10$mA $V_{CE} = 15$V
BV_{CBO}	Collector to Base Breakdown Voltage	45			45			Volts	$I_C = 0.1$ mA $I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 3]	45			45			Volts	$I_C = 10$ mA $I_B = 0$ (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	$I_E = .01$ mA $I_C = 0$
h_{fe}	High Frequency Current Gain (f = 100 mc)	2.0	3.5		2.0	3.5			$I_C = 10$ mA $V_{CE} = 15$V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(5) f = 1.0 mc; $R_S = 300\Omega$.
(6) Reference: Gertzis, S. and Basselaers, R.— Characterization of R.F. Transistors for AM/FM Radio Applications. IRE, PGBTR, Trans., Nov. 1962.

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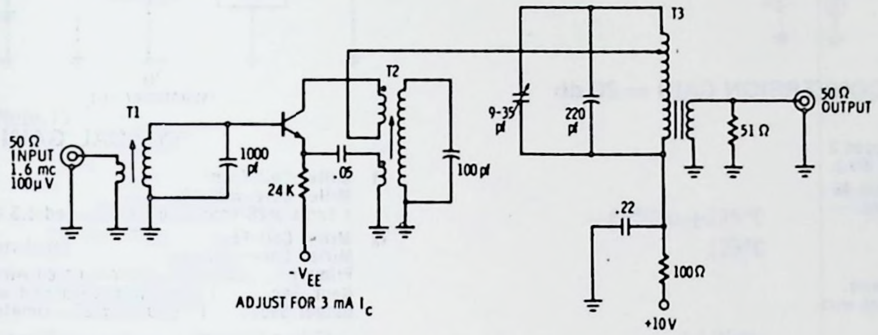
1.6 MC TO 455 KC AUTODYNE CONVERSION GAIN TEST CIRCUIT

$I_C = 2.0\text{-}3.0$ mA $\quad V_{CE} = 10V$



T1
50 Ω INPUT 1.6 mc 100 μV
1000 pf
24 K
.05
T2
100 pf
$-V_{EE}$
ADJUST FOR 3 mA I_C
9-35 pf
220 pf
T3
51 Ω
50 Ω OUTPUT
.22
100Ω
+10V

TYPICAL GAIN = 42 db

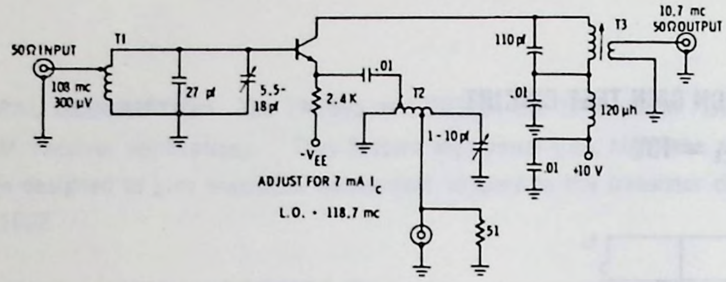
T1 Miller Coil Form
Miller Slug #30-106 Core
Primary . . . 6 T #28 enameled wire
Secondary . . . 28 T #36 enameled wire

T2 Miller Coil Form
Miller Core #30-106
4 Turns #28 Enameled Wire
60 Turns #36 Enameled Wire
1½ Turns #28 Enameled Wire

T3 Miller #2032 455 KC Transformer
Center Core only

108 MC TO 10.7 MC CONVERSION GAIN TEST CIRCUIT

$I_C = 7.0$ mA $V_{CE} = 10V$


50Ω INPUT
108 mc
300 μV
T1
27 pf
5.5-18 pf
2.4 K
-V_EE
ADJUST FOR 7 mA I_C
.01
T2
1-10 pf
L.O. - 118.7 mc
51
110 pf
.01
120 μh
.01
+10 V
T3
10.7 mc
50Ω OUTPUT

TYPICAL CONVERSION GAIN = 20 db

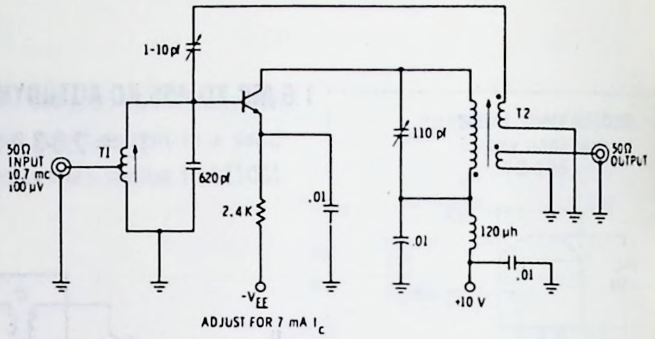
T1 2.5 turns #16 tinned copper wire tapped 2 turns from Gnd. Coil dia. 3⁄8" (inside dia.).

T2 4 turns #16 tinned copper wire tapped 3⁄4 turn from Gnd. and 1¼ turns from Gnd. Coil dia. ¼" (inside dia.).

T3 Miller Coil Form
Miller Core #30-106
Primary . . . 10 turns #36 enameled wire.
Secondary . . . 1⅓ turns #28 enameled wire.

10.7 MC NEUTRALIZED POWER GAIN TEST CIRCUIT

$I_C = 7.0$ mA $V_{CE} = 10V$


1-10 pf
50Ω INPUT
10.7 mc
100 μV
T1
620 pf
2.4 K
-V_EE
ADJUST FOR 7 mA I_C
.01
110 pf
.01
T2
120 μh
.01
+10 V
50Ω OUTPUT

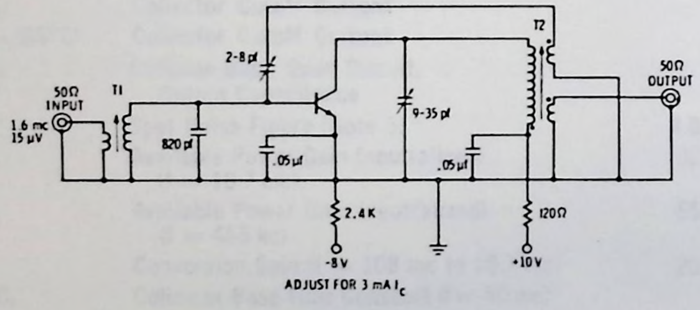
TYPICAL GAIN = 32 db

T1 Miller Coil Form
Miller Core #30-106
4 turns #28 enameled wire tapped 1.5 turns from Gnd.

T2 Miller Coil Form
Miller Core #30-106
Primary . . . 10 turns #36 enameled wire.
Neut. Sec. . . . 5 turns #36 enameled wire (Bifilar).
Output Sec. . . . 1.33 turns #28 enameled wire (Overwind).

NEUTRALIZED A.M. R.F. AMPLIFIER TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10V$


50Ω INPUT
1.6 mc
15 μV
T1
820 pf
2-8 pf
.05 μf
2.4 K
-8 V
ADJUST FOR 3 mA I_C
9-35 pf
.05 μf
T2
120Ω
+10V
50Ω OUTPUT

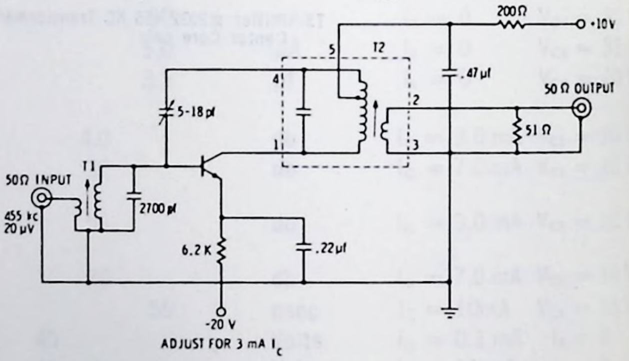
TYPICAL GAIN = 46 db

T1 28 T #36 Nyclad Secondary
6 T #28 Nyclad Primary
Miller #80-106 Core

T2 120 T #40 S.S. Enl. Primary
40 T #40 S.S. Enl. Neut. Sec.
7 T #28 Nyclad Output Sec., wave wound
Bifilar with cold end of Primary.

455 KC NEUTRALIZED A.M. I.F. AMPLIFIER TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10V$


200Ω
+10V
T2
5
4
1
2
3
.47 μf
5-18 pf
50Ω INPUT
455 kc
20 μV
T1
2700 pf
6.2 K
-20 V
ADJUST FOR 3 mA I_C
.22 μf
51 Ω
50 Ω OUTPUT

TYPICAL GAIN = 55 db

T1 13 T Primary #26 Nyclad
54 T Secondary #36 Nyclad } Miller #30-106 Core
.043 mh

T2 Miller Min. I.F. Transformer #2032.

FT3722

NPN HIGH-VOLTAGE, HIGH-CURRENT SWITCH

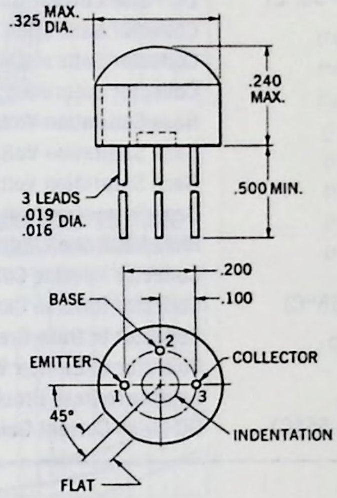
SILICON PLANAR* EPITAXIAL TRANSISTOR

HIGH BREAKDOWN . . . . LV_{CEO} = 60 V (MIN)
HIGH FREQUENCY . . . . f_T = 300 MHz (MIN)
FAST HIGH CURRENT SWITCHING . . . t_{on} = 50 ns (MAX); t_{off} = 100 ns (MAX) AT 500 mA
LOW $V_{CE(sat)}$ . . . . $V_{CE(sat)}$ = 0.5 V (MAX) AT 500 mA
LOW OUTPUT CAPACITANCE . . . . . . C_{cb} = 10 pF (MAX)

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +125°C
Operating Junction Temperature		125°C
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		4.0 Watts
at 25°C Ambient Temperature (Notes 2 and 3)		0.5 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	80 Volts
V_{CES}	Collector to Emitter Voltage	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
	Maximum Collector Current (Note 5)	1.0 Amp

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

*Planar is a patented Fairchild process.

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	60			Volts	I_C = 10 mA (pulsed)	I_B = 0
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)		0.35	0.5	Volts	I_C = 500 mA	I_B = 50 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.25	0.37	Volts	I_C = 300 mA	I_B = 30 mA
t_{on}	**Turn-on Time** (Note 6)		20	50	ns	I_C ≈ 500 mA	I_{B1} ≈ 50 mA
t_{off}	**Turn-off Time** (Note 6)		63	100	ns	I_C ≈ 500 mA, I_{B2} ≈ −50 mA	I_{B1} ≈ 50 mA,
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	3.0	4.0			I_C = 50 mA	V_{CE} = 10 V
C_{cb}	**Collector-Base Capacitance**		5.5	10	pF	I_E = 0	V_{CB} = 10 V
C_{eb}	Emitter Base Capacitance		50	65	pF	I_C = 0	V_{BE} = −0.5 V

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

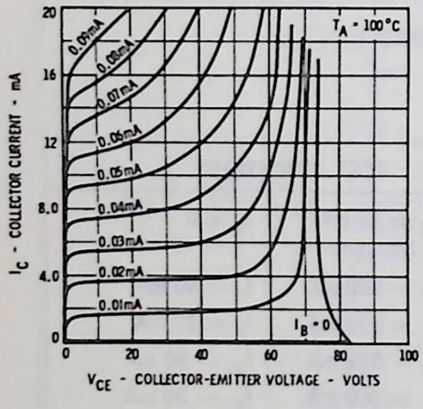
FAIRCHILD TRANSISTOR FT3722

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

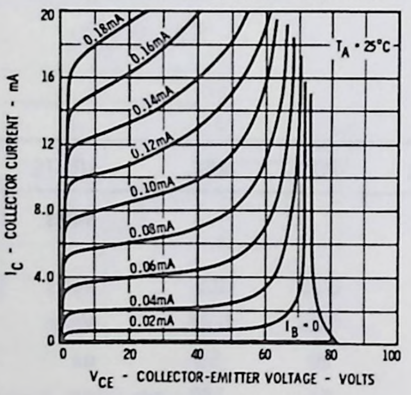
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	70	150		$I_C = 100$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	25	45			$I_C = 10$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	35			$I_C = 300$ mA	$V_{CE} = 2.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	15	30			$I_C = 500$ mA	$V_{CE} = 2.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	12	25			$I_C = 800$ mA	$V_{CE} = 5.0$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	15	30			$I_C = 100$ mA	$V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.15	0.22	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.16	0.25	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.6	2.0	Volts	$I_C = 800$ mA	$I_B = 80$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.62	0.75	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.73	0.85	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.89	1.1	Volts	$I_C = 300$ mA	$I_B = 30$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)	0.86	0.91	1.2	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		1.0	1.5	Volts	$I_C = 800$ mA	$I_B = 80$ mA
I_{CES}	Collector Reverse Current		0.1	0.5	μA	$V_{CE} = 40$ V	$V_{EB} = 0$
I_{CES}(65°C)	Collector Reverse Current		2.0	10	μA	$V_{CE} = 40$ V	$V_{EB} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	80			Volts	$I_C = 100$ μA	$I_E = 0$
B_{CES}	Collector to Emitter Breakdown Voltage	80			Volts	$I_C = 100$ μA	$V_{EB} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			Volts	$I_C = 0$	$I_E = 100$ μA
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	20				$I_C = 200$ mA	$V_{CE} = 2.0$ V

TYPICAL ELECTRICAL CHARACTERISTICS

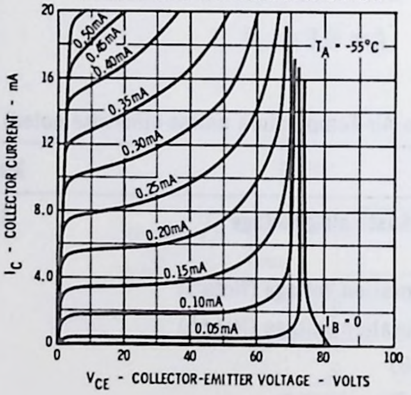
COLLECTOR CHARACTERISTICS *



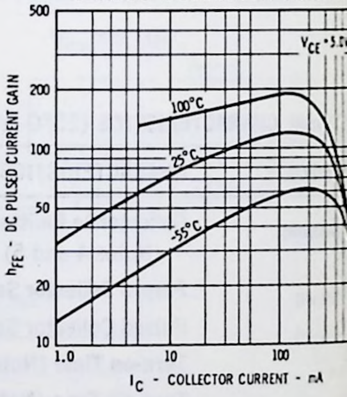
COLLECTOR CHARACTERISTICS *



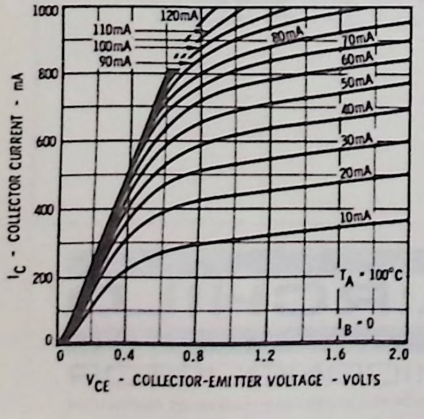
COLLECTOR CHARACTERISTICS *



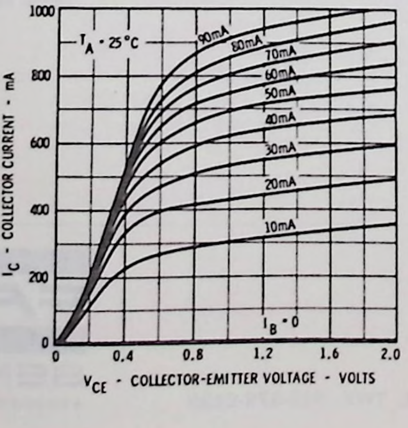
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURREN



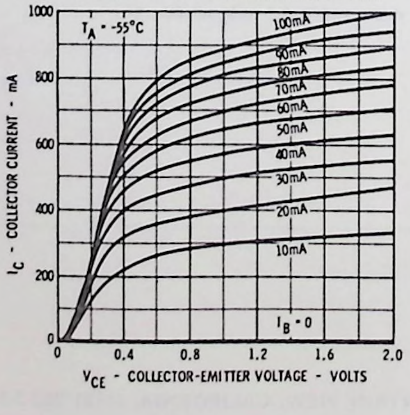
COLLECTOR CHARACTERISTICS *



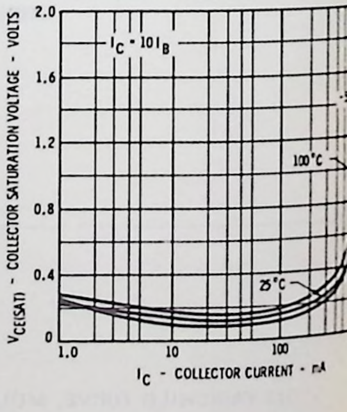
COLLECTOR CHARACTERISTICS *



COLLECTOR CHARACTERISTICS *



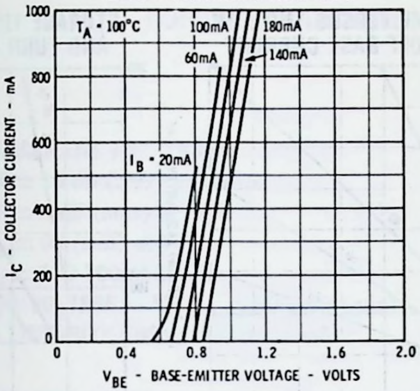
COLLECTOR SATURATION VOLT VERSUS COLLECTOR CURREN



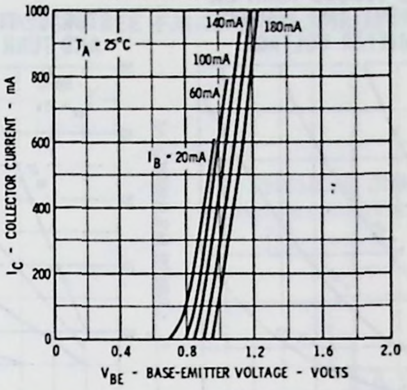
* Single Family Characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

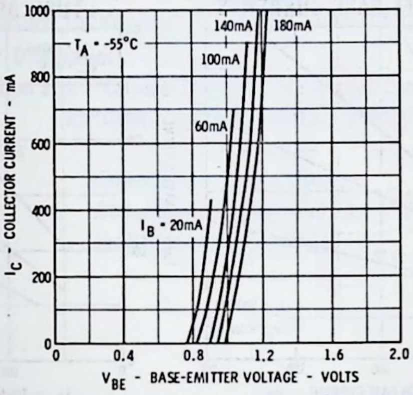
BASE CHARACTERISTICS*



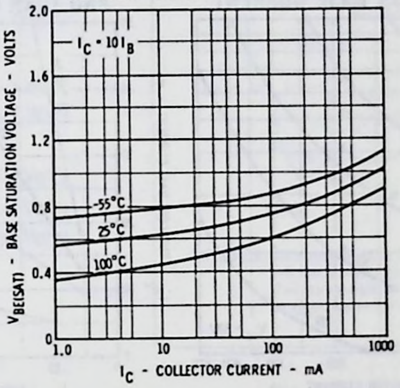
BASE CHARACTERISTICS *



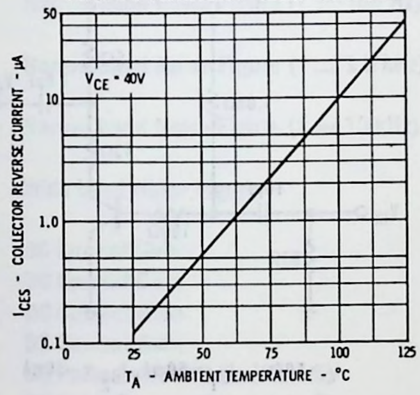
BASE CHARACTERISTICS*



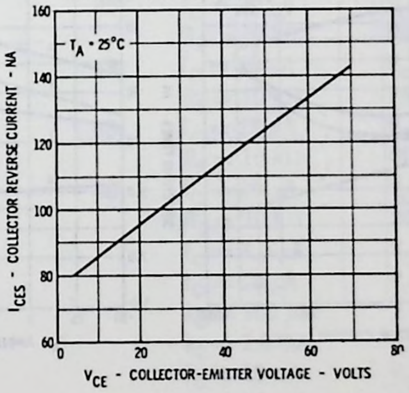
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



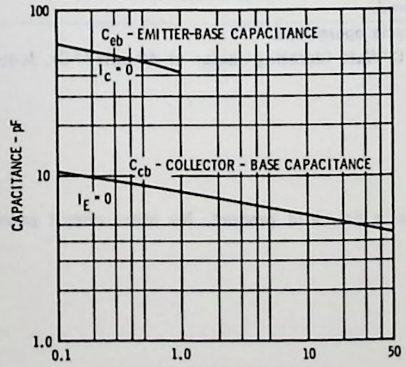
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



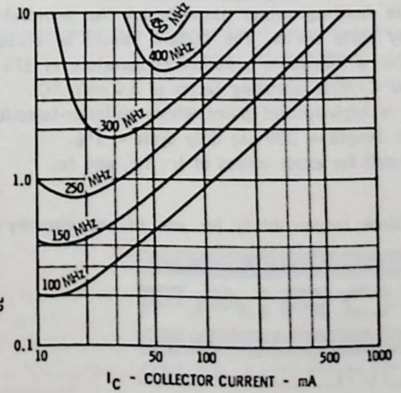
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



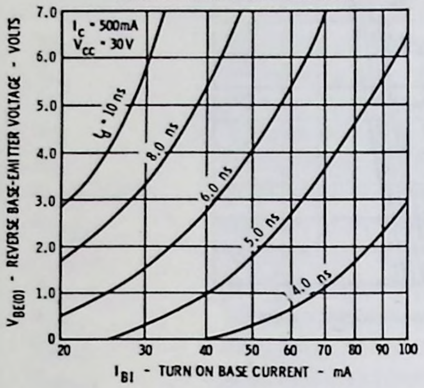
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



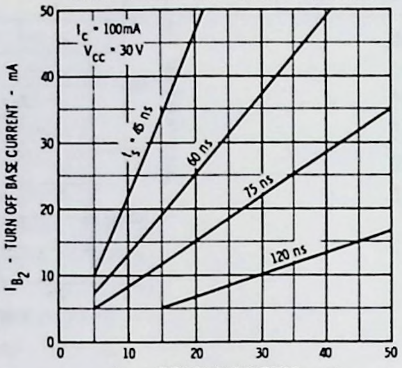
* Single Family Characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

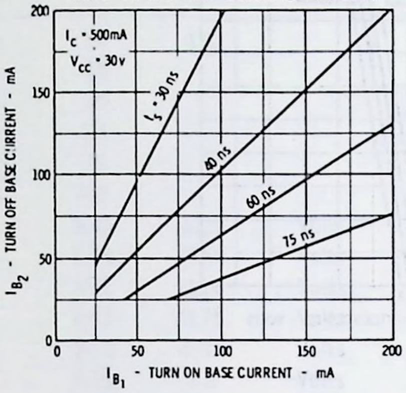
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



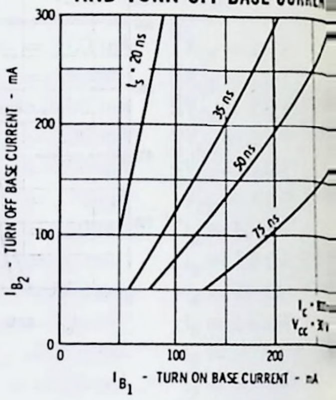
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



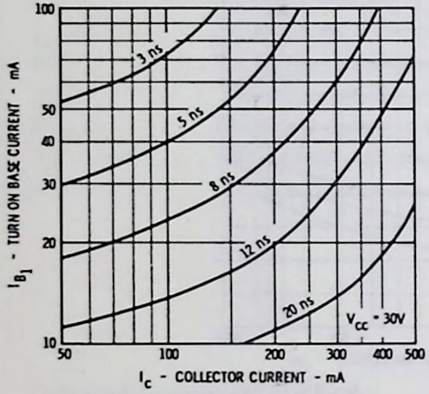
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



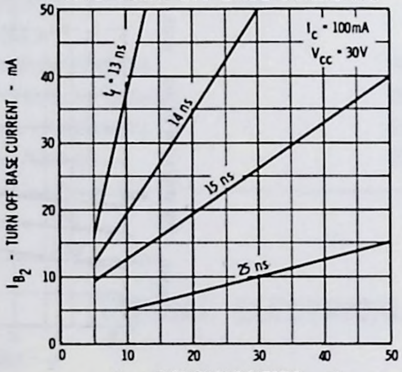
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



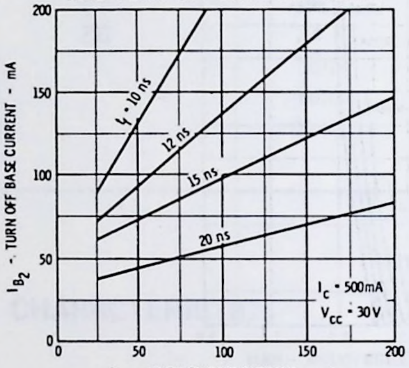
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



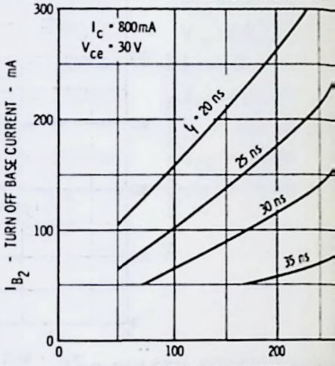
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



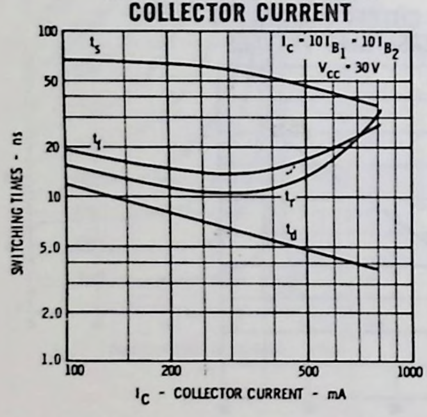
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



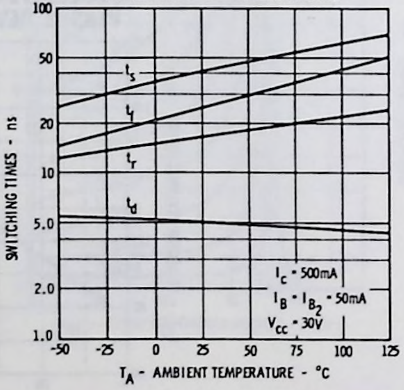
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



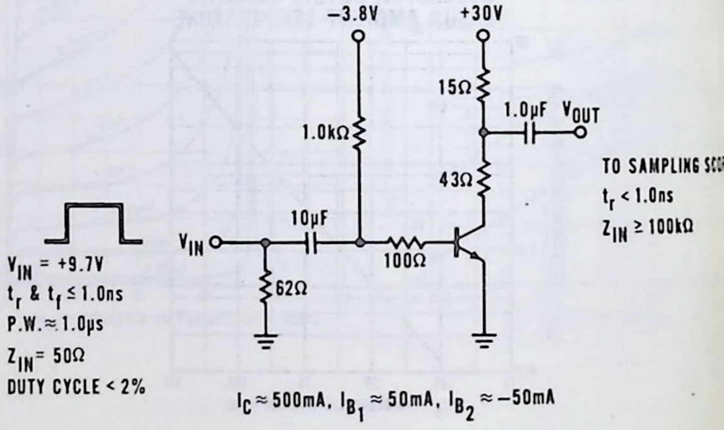
SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIME TEST CIRCUIT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C). Junction to ambient therm resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

Fairchild cannot assume responsibility for use of any circuitry described other than circuitry entirely embodied in a Fairchild product. No other circuit patent licenses are impl

EN3962

PNP LOW LEVEL, LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

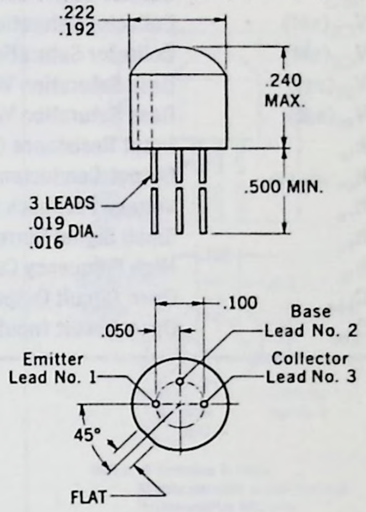
FOR TEST CIRCUITS AND ADDITIONAL DESIGN INFORMATION SEE FAIRCHILD 2N3962 DATA SHEET

ELECTRICAL REPLACEMENT FOR 2N3962
LOW NOISE - - NF = 10 dB (max) at 100Hz
- - NF = 3 dB (max) at 1kHz
HIGH GAIN - - h_{FE} = 60 (min) at 1μA
- - h_{FE} = 100-300 at 10μA
HIGH BREAKDOWN VOLTAGE - - LV_{CEO} = 60 Volts (min)
XCELLENT BETA LINEARITY FROM 1μA to 50 mA

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperatures	−55°C to +125°C
Operating Junction Temperatures	125°C
Lead Temperature (Soldering, 10 second time limit)	260°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
25°C Ambient Temperature (Notes 2 and 3)	0.2 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	−60 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	−60 Volts
V_{EBO} Emitter to Base Voltage	−6.0 Volts

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	**Narrow band Noise Figure (f = 100 Hz)**		3.0	10	dB	I_C = 20 μA V_{CE} = −0.5 V R_S = 10 kΩ PBW = 15 Hz
NF	**Narrow band Noise Figure (f = 1.0 kHz)**		0.8	3.0	dB	I_C = 20 μA V_{CE} = −5.0 V R_S = 10 kΩ PBW = 150 Hz
NF	Narrow band Noise Figure (f = 10 kHz)		0.8	3.0	dB	I_C = 20 μA V_{CE} = −5.0 V R_S = 10 kΩ PBW = 1.5 kHz
NF	Wide band Noise Figure		1.0	3.0	dB	I_C = 20 μA V_{CE} = −5.0 V R_S = 10 kΩ PBW = 15.7 kHz
h_{FE}	**DC Current Gain**	60	175			I_C = 1.0 μA V_{CE} = −5.0 V
h_{FE}	**DC Current Gain**	100	210	300		I_C = 10 μA V_{CE} = −5.0 V
h_{FE}	**DC Current Gain**	100	240			I_C = 100 μA V_{CE} = −5.0 V
h_{FE}	**DC Current Gain**	100	260	450		I_C = 1.0 mA V_{CE} = −5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	100	280			I_C = 10 mA V_{CE} = −5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	90	260			I_C = 50 mA V_{CE} = −5.0 V
h_{FE}(−55°C)	DC Current Gain	40	90			I_C = 10 μA V_{CE} = −5.0 V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	45	150			I_C = 50 mA V_{CE} = −5.0 V
h_{FE}(100°C)	DC Current Gain		375	600		I_C = 1.0 mA V_{CE} = −5.0 V

*Planar is a patented Fairchild process.

FAIRCHILD TRANSISTORS EN3962

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CBO}	Collector to Base Breakdown Voltage	−60			Volts	$I_C = 10\ \mu A$	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−60			Volts	$I_C = 10\ \mu A$	$I_B = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage (Notes 4 and 5)**	**−60**			Volts	$I_C = 5.0$ mA(pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−6.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
I_{CES}	Collector Reverse Current		0.5	50	nA	$V_{CE} = -50$ V	$V_{EB} = 0$
I_{CES}(100°C)	Collector Reverse Current		2.0	10	μA	$V_{CE} = -50$ V	$V_{EB} = 0$
I_{EBO}	Emitter Cutoff Current			10	nA	$I_C = 0$	$V_{EB} = -4.0$ V
V_{CE}(sat)	Collector Saturation Voltage		−0.1	−0.25	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		−0.16	−0.4	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{BE}(sat)	Base Saturation Voltage		−0.72	−0.9	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		−0.81	−0.95	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
h_{ie}	Input Resistance (f = 1.0 kHz)	2.5	8.0	17	kΩ	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{oe}	Output Conductance (f = 1.0 kHz)	5.0	19	40	μmho	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)			10	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	100	300	550		$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{fe}	High Frequency Current Gain (f = 20MHz)	2.0		8.0		$I_C = 0.5$ mA	$V_{CE} = -5.0$ V
C_{obo}	Open Circuit Output Capacitance			6.0	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{ibo}	Open Circuit Input Capacitance			16	pF	$I_C = 0$	$V_{EB} = -0.5$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on application involving pulsed or low-duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C; junction-to-am thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

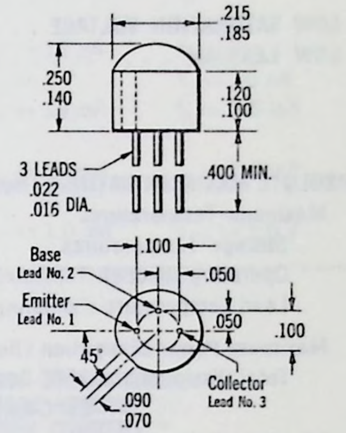
(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

SE4001 · SE4002 · SE4010
NPN HIGH-GAIN, LOW NOISE TYPE
DIFFUSED SILICON PLANAR* TRANSISTORS

The Fairchild SE4001, SE4002, and SE4010 are very high beta NPN silicon PLANAR transistors suitable for high gain udio pre-amplifier stages and direct coupled circuits. The SE4010 is selected for low noise applications. They also eature the solid package designed to give maximum mechanical support to the transistor chip.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Operating Junction Temperature	125°C Maximum
Storage Temperature	−55°C to +125°C
Soldering Temperature (10 sec. time limit)	260°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Note 2]	0.5 Watt
at 65°C Case Temperature [Note 2]	0.3 Watt
at 25°C Ambient Temperature [Note 2]	0.2 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	30 Volts
V_{CEO} Collector to Emitter Voltage [Note 3]	25 Volts
V_{EBO} Emitter to Base Voltage	6.0 Volts

LECTRICAL CHARACTERISTICS

5°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	SE4001 Min.	SE4001 Typ.	SE4001 Max.	SE4002 Min.	SE4002 Typ.	SE4002 Max.	SE4010 Min.	SE4010 Typ.	SE4010 Max.	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain	60	220	300	200	350	1000	200	350	1000		$I_C = 1.0$ mA $V_{CE} = 10$ V
h_{FE}	DC Current Gain		50			100			100			$I_C = 50\ \mu A$ $V_{CE} = 10$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)							1.0	1.3			$I_C = 50\ \mu A$ $V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0			3.0			3.0				$I_C = 1.0$ mA $V_{CE} = 5.0$ V
NF	Narrow Band Noise Figure [Note 5]								1.5	3.0	dB	$I_C = 30\ \mu A$ $V_{CE} = 5.0$ V
V_{CE} (sat)	Collector Saturation Voltage			0.35			0.35			0.35	Volts	$I_C = 1.0$ mA $I_B = 0.1$ mA
I_{CBO}	Collector Cutoff Current			200			200			200	nA	$I_E = 0$ $V_{CB} = 5.0$ V
I_{CBO} (65°C)	Collector Cutoff Current			3.0			3.0			3.0	μA	$I_E = 0$ $V_{CB} = 5.0$ V
C_{obo}	Output Capacitance			4.0			4.0			4.0	pF	$I_E = 0$ $V_{CB} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	30			30			30			Volts	$I_C = 100\ \mu A$ $I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 3 and 4]	25			25			25			Volts	$I_C = 10$ mA $I_B = 0$ (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			6.0			Volts	$I_E = 100\ \mu A$ $I_C = 0$

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
(3) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(4) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(5) $R_S = 10\ k\Omega$; f = 1 kHz; Power Bandwidth of 200 Hz.

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FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FT107C • SE4020

NPN LOW LEVEL, LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **LOW 1/f NOISE . . . . NF = 2.5 dB (TYP) AT 100 Hz; 1.0 kΩ**
- **HIGH GAIN . . . . $h_{FE} = 100$ (MIN) AT 10 μA**
  $h_{FE} = 150$ (MIN) AT 10 mA
- **LOW SATURATION VOLTAGE . . . $V_{CE(sat)} = 0.2$ V (MAX) AT 10 mA/0.5 mA**
- **LOW LEAKAGE . . . . $I_{CBO} = 2.0$ nA (MAX) AT $V_{CB} = 45$ V**
  $I_{CBO} = 50$ nA (MAX) AT $V_{CB} = 45$ V, $T_A = 65°C$ (SE4020)
  $I_{CBO} = 1.0$ μA (MAX) AT $V_{CB} = 45$ V, $T_A = 125°C$ (FT107C)

ABSOLUTE MAXIMUM RATINGS (Note 1)

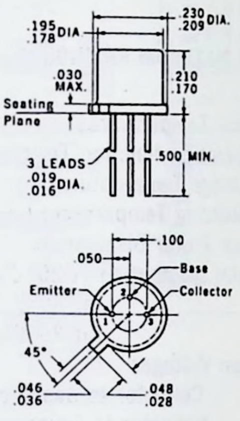
		FT107C	SE4020
Maximum Temperatures			
Storage Temperatures		−65°C to +150°C	−65°C to +125°C
Operating Junction Temperatures		+150°C	+125°C
Lead Temperature (Soldering, 10 seconds time limit)		+300°C	+260°C
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		0.86 Watt	0.5 Watt
25°C Ambient Temperature		0.26 Watt	0.2 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	60 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	8.0 Volts	8.0 Volts
I_C	Continuous Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		2.5	6.0	dB	$I_C = 100$ μA $V_{CE} = 5.0$ V $R_S = 1.0$ kΩ BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		1.5	3.0	dB	$I_C = 10$ μA $V_{CE} = 5.0$ V $R_S = 10$ kΩ BW = 400 Hz
NF	**Narrow-Band Noise Figure (f = 100 Hz)**		**2.5**		**dB**	**$I_C = 100$ μA $V_{CE} = 5.0$ V** **$R_S = 1.0$ kΩ BW = 8.0 Hz**
NF	Wide-Band Noise Figure (f = 10 Hz to 10 kHz)		1.5	3.0	dB	$I_C = 10$ μA $V_{CE} = 5.0$ V $R_S = 10$ kΩ BW = 15.7 kHz
h_{FE}	**DC Current Gain**	**100**	**205**			**$I_C = 10$ μA $V_{CE} = 5.0$ V**
h_{FE}	DC Current Gain	120	245			$I_C = 100$ μA $V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	135	290			$I_C = 1.0$ mA $V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**150**	**310**	**950**		**$I_C = 10$ mA $V_{CE} = 5.0$ V**
$h_{FE}(-55°C)$	DC Current Gain	25				$I_C = 10$ μA $V_{CE} = 5.0$ V
$h_{FE}(100°C)$	DC Pulse Current Gain (FT107C) (Note 5)		400	1450		$I_C = 10$ mA $V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.0	2.0			$I_C = 10$ mA $V_{CE} = 5.0$ V

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline

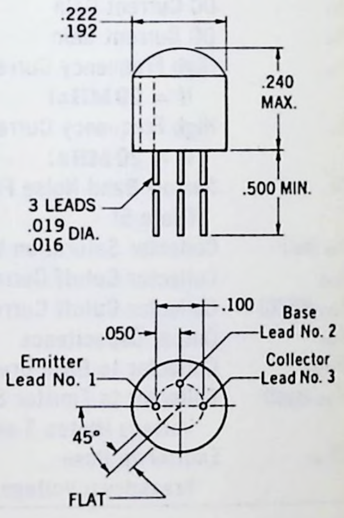


NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

FT107C

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

SE4020

*Planar is a patented Fairchild process

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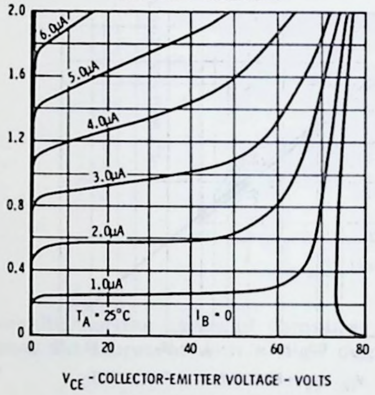
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

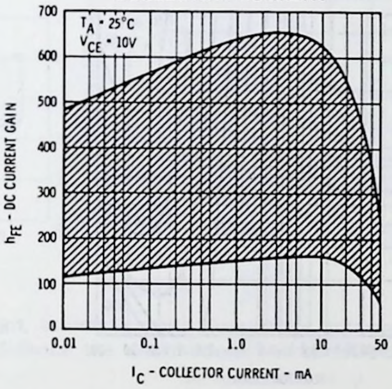
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	**Collector Cutoff Current**		**0.2**	**2.0**	**nA**	**$I_E = 0$**	**$V_{CB} = 45$ V**
I_{CBO}(65°C)	**Collector Cutoff Current** (SE4020)		**3.0**	**50**	**nA**	**$I_E = 0$**	**$V_{CB} = 45$ V**
I_{CBO}(125°C)	**Collector Cutoff Current** (FT107C)		**0.1**	**1.0**	**μA**	**$I_E = 0$**	**$V_{CB} = 45$ V**
I_{EBO}	Emitter Cutoff Current		0.007	1.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{cb}	Collector to Base Capacitance		2.5	4.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter to Base Capacitance		4.0	6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60			Volts	$I_C = 5.0$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	60			Volts	$I_C = 10\ \mu$A	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0			Volts	$I_C = 0$	$I_E = 10\ \mu$A
$V_{CE(sat)}$	**Pulsed Collector to Emitter Saturation Voltage** (Note 5)		**0.12**	**0.2**	**Volt**	**$I_C = 10$ mA**	**$I_B = 0.5$ mA**
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		0.17	0.3	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(on)}$	Base to Emitter On Voltage		0.64	0.7	Volt	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

TYPICAL ELECTRICAL CHARACTERISTICS

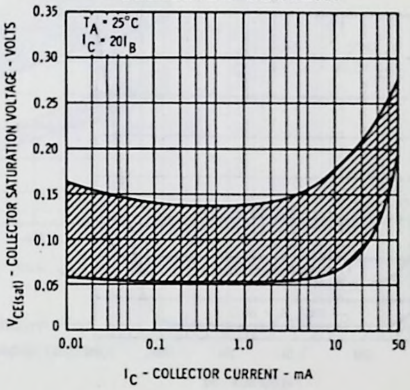
COLLECTOR CHARACTERISTICS[§] ACTIVE REGION



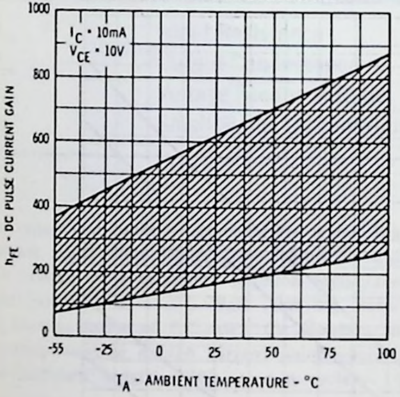
DC CURRENT GAIN VERSUS COLLECTOR CURRENT[||]



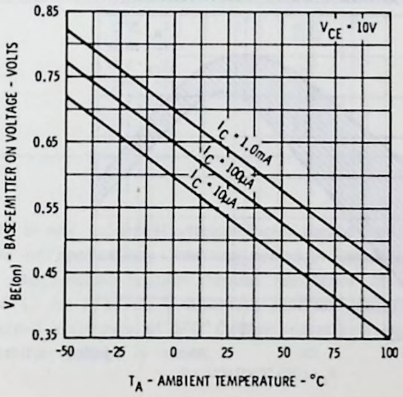
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT[||]



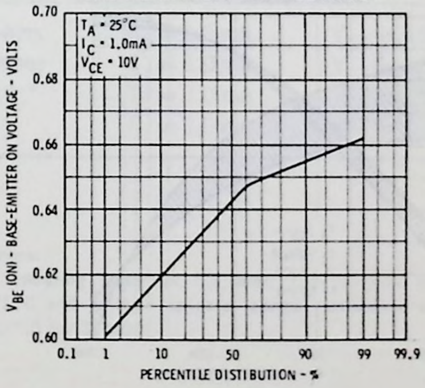
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE[||]



BASE-EMITTER ON VOLTAGE VERSUS AMBIENT TEMPERATURE



DISTRIBUTION OF BASE-EMITTER ON VOLTAGE[||]

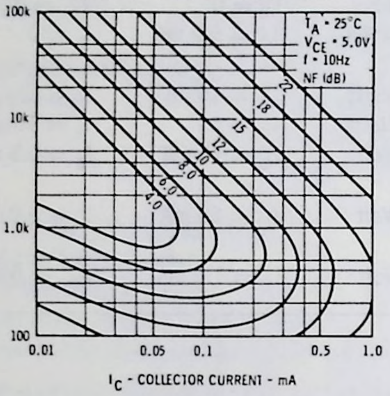


[§] Single family characteristic on Transistor Curve Tracer.

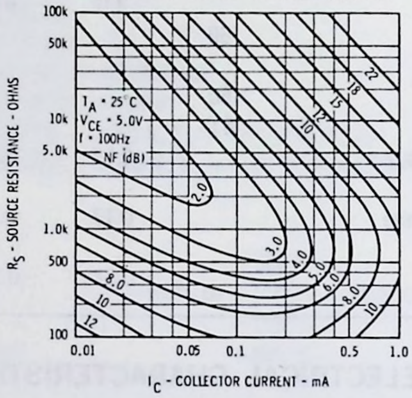
[||] In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

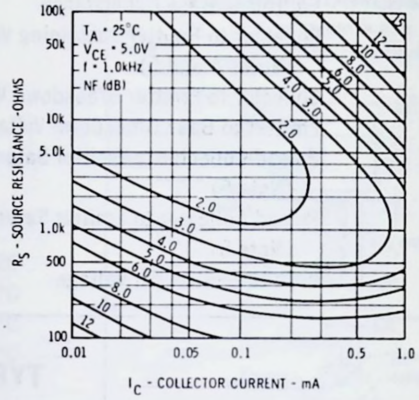
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



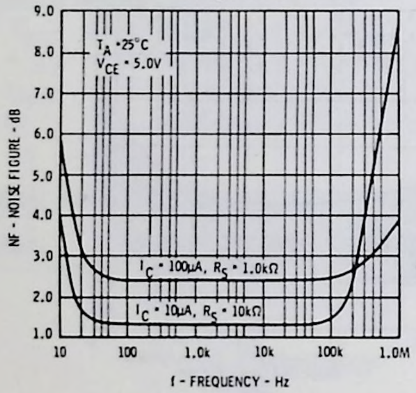
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



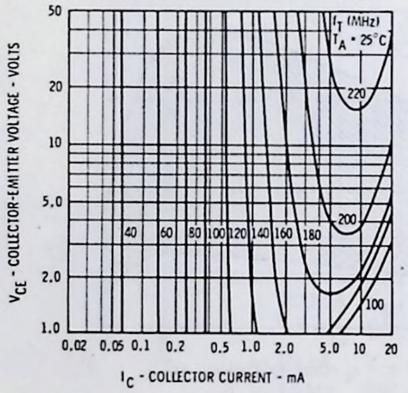
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



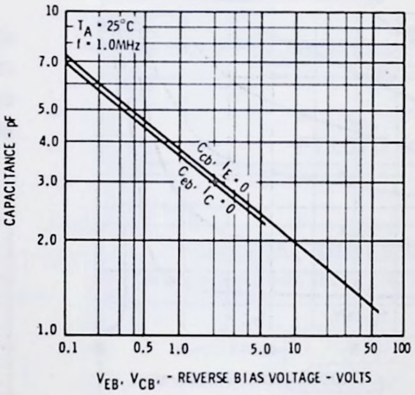
NOISE FIGURE VERSUS FREQUENCY



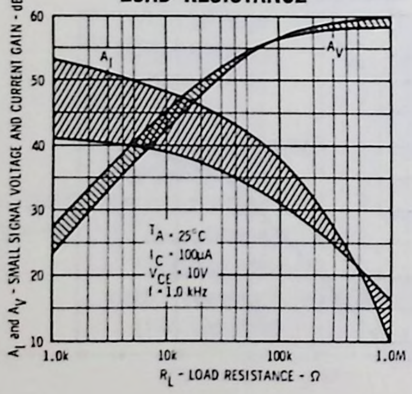
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



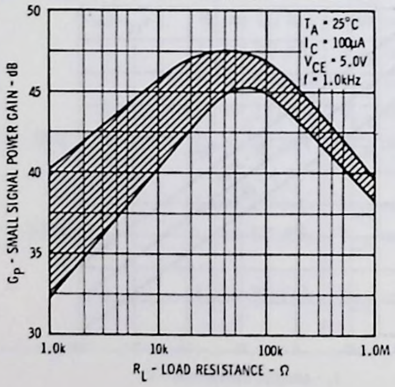
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



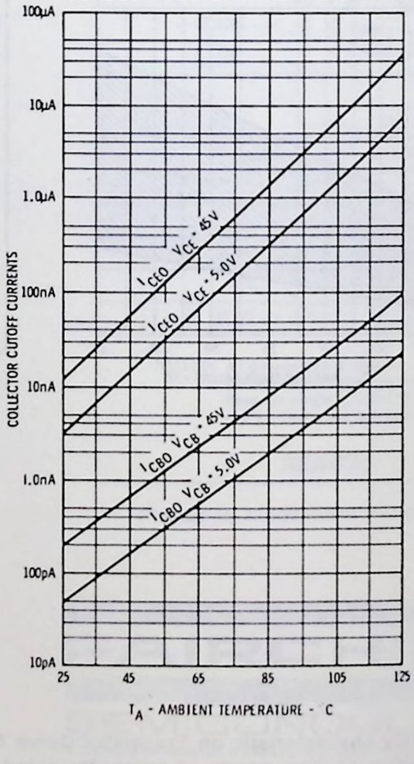
SMALL SIGNAL VOLTAGE AND CURRENT GAIN VERSUS LOAD RESISTANCE**



SMALL SIGNAL POWER GAIN VERSUS LOAD RESISTANCE**



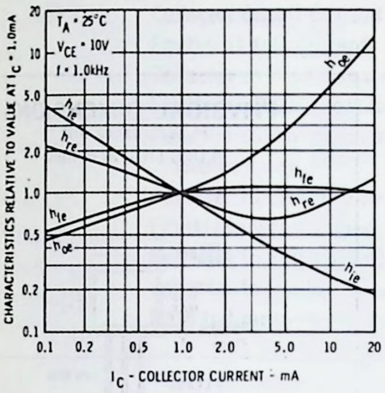
COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



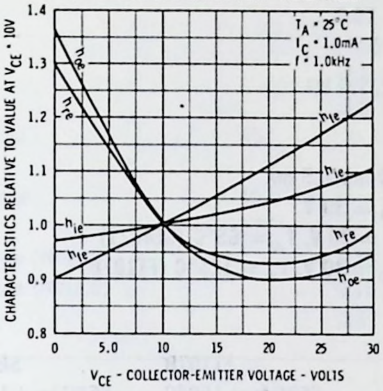
** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

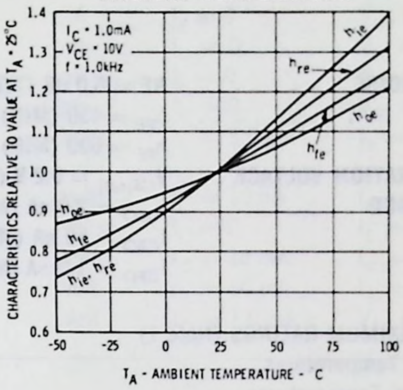
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



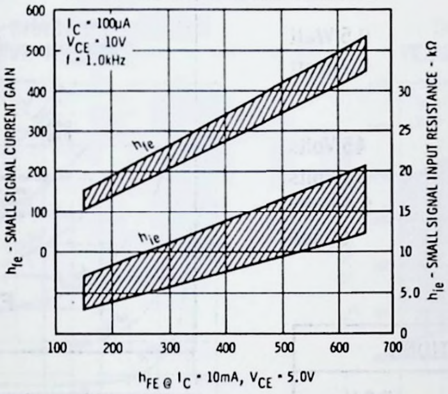
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



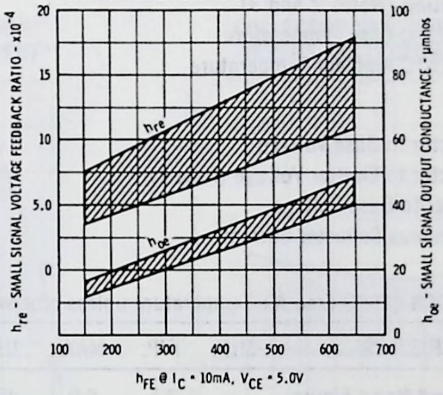
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



h PARAMETER CORRELATIONS**



h PARAMETER CORRELATIONS**



In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

LL. SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	8.5	kohms	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{oe}	Output Conductance	24	μmhos	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{re}	Voltage Feedback Ratio	7.0	x10⁻⁴	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain	335		$I_C = 1.0$ mA	$V_{CE} = 10$ V

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction to ambient thermal resistance of 480°C/Watt (derating factor of 2.1 mW/°C) for FT107C. A maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C) for SE4020.

This rating refers to a high current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

FT107B • SE4021

NPN LOW LEVEL, LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **LOW 1/f NOISE . . . . NF = 6.0 dB (TYP) AT 10 Hz, 1.0 kΩ**
- **HIGH GAIN . . . . h_{FE} = 450 (MIN) AT 10 μA**
  h_{FE} = 600 (MIN) AT 10 mA
- **LOW SATURATION VOLTAGE . . . $V_{CE(sat)}$ = 0.2 V (MAX) AT 10 mA/0.5 mA**
- **LOW LEAKAGE . . . . I_{CBO} = 2.0 nA (MAX) AT V_{CB} = 30 V**
  I_{CBO} = 50 nA (MAX) AT V_{CB} = 30 V, T_A = 65°C (SE4021)
  I_{CBO} = 1.0 μA (MAX) AT V_{CB} = 30 V, T_A = 125°C (FT107B)

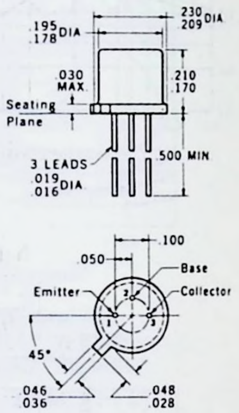
ABSOLUTE MAXIMUM RATINGS (Note 1)

		FT107B	SE4021
Maximum Temperatures			
Storage Temperatures		−65°C to +150°C	−65°C to +125°C
Operating Junction Temperatures		+150°C	+125°C
Lead Temperature (Soldering, 10 seconds time limit)		+300°C	+260°C
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		0.86 Watt	0.5 Watt
25°C Ambient Temperature		0.26 Watt	0.2 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	45 Volts	45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts	45 Volts
V_{EBO}	Emitter to Base Voltage	8.0 Volts	8.0 Volts
I_C	Continuous Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		3.5	6.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 1.0 kΩ BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		1.5	4.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 10 kΩ BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		2.5	8.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 100 kΩ BW = 400 Hz
NF	Narrow-Band Noise Figure (f = 100 Hz)		3.5			I_C = 100 μA V_{CE} = 5.0 V R_S = 1.0 kΩ BW = 8.0 Hz
NF	**Narrow-Band Noise Figure (f = 10 Hz)**		**6.0**	(Note 6)	**dB**	**I_C = 100 μA V_{CE} = 5.0 V** **R_S = 1.0 kΩ BW = 10 Hz**
NF	Narrow-Band Noise Figure (f = 1.0 kHz)		1.5	3.0	dB	I_C = 10 μA V_{CE} = 5.0 V R_S = 10 kΩ BW = 400 Hz
NF	Wide-Band Noise Figure (f = 10 Hz to 10 kHz)		1.5	3.0	dB	I_C = 10 μA V_{CE} = 5.0 V R_S = 10 kΩ BW = 15.7 kHz
h_{FE}	**DC Current Gain**	**450**	735			**I_C = 10 μA V_{CE} = 5.0 V**
h_{FE}	DC Current Gain	500	840			I_C = 100 μA V_{CE} = 5.0 V
h_{FE}	DC Current Gain	550	960			I_C = 1.0 mA V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain (Note 5)**	**600**	**950**	**1550**		**I_C = 10 mA V_{CE} = 5.0 V**
h_{FE}(−55°C)	DC Current Gain	130				I_C = 10 μA V_{CE} = 5.0 V
h_{FE}(100°C)	DC Pulse Current Gain (FT107B) (Note 5)		1200	2300		I_C = 10 mA V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.5	2.6			I_C = 10 mA V_{CE} = 5.0 V

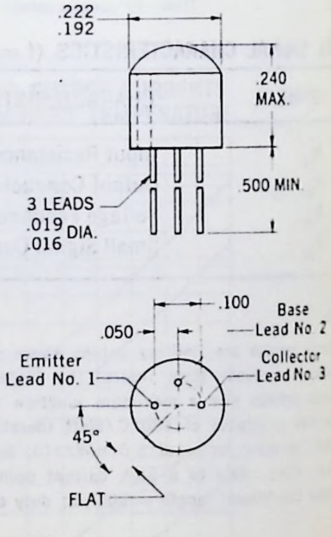
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

FT107B

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non conductive material

SE4021

*Planar is a patented Fairchild proc

FAIRCHILD
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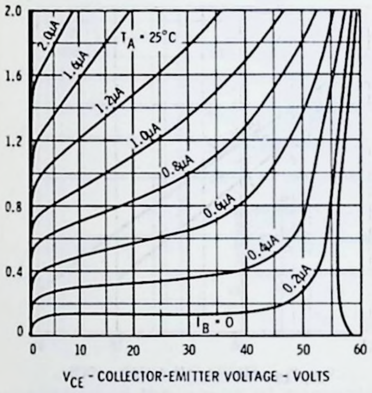
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

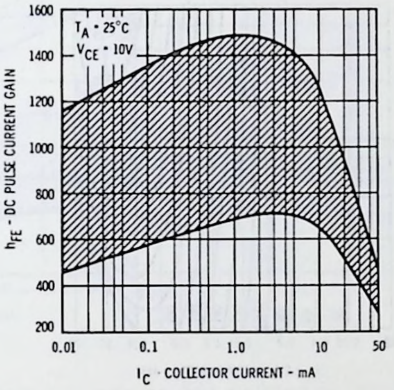
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	**Collector Cutoff Current**		0.1	2.0	nA	$I_E = 0$	$V_{CB} = 30$ V
I_{CBO}(65°C)	**Collector Cutoff Current (SE4021)**		1.0	50	nA	$I_E = 0$	$V_{CB} = 30$ V
I_{CBO}(125°C)	**Collector Cutoff Current (FT107B)**		0.07	1.0	μA	$I_E = 0$	$V_{CB} = 30$ V
I_{EBO}	Emitter Cutoff Current		0.005	1.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{cb}	Collector to Base Capacitance		2.5	4.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter to Base Capacitance		3.5	6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	45			Volts	$I_C = 5.0$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	45			Volts	$I_C = 10$ μA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0			Volts	$I_C = 0$	$I_E = 10$ μA
$V_{CE(sat)}$	**Collector to Emitter Saturation Voltage** (Note 5)		**0.12**	**0.2**	**Volt**	**$I_C = 10$ mA**	**$I_B = 0.5$ mA**
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.18	0.3	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(on)}$	Base to Emitter On Voltage		0.62	0.7	Volt	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

TYPICAL ELECTRICAL CHARACTERISTICS

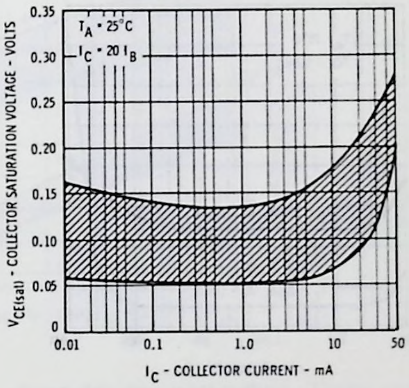
COLLECTOR CHARACTERISTICS* ACTIVE REGION



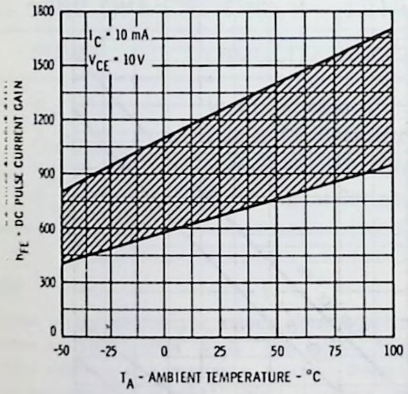
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT**



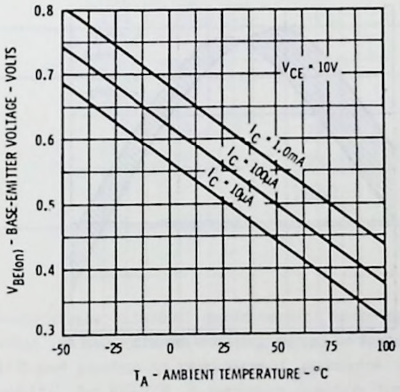
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT**



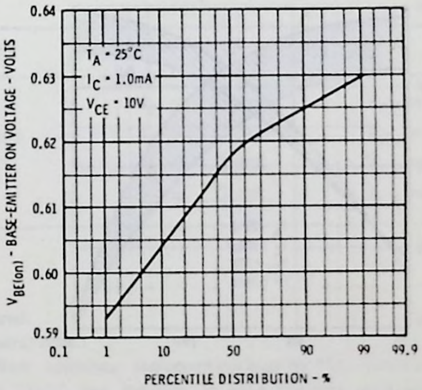
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE**



BASE-EMITTER ON VOLTAGE VERSUS AMBIENT TEMPERATURE



DISTRIBUTION OF BASE-EMITTER ON VOLTAGE**



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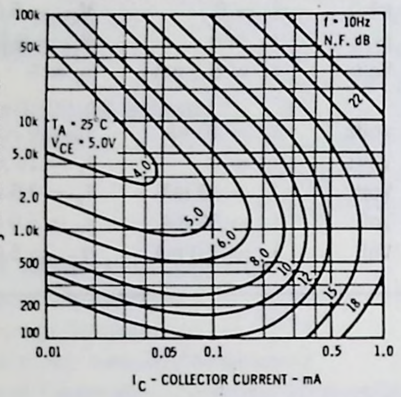
*Single family characteristics on Curve Tracer.

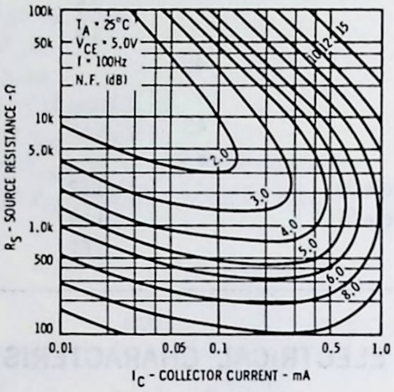
**In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

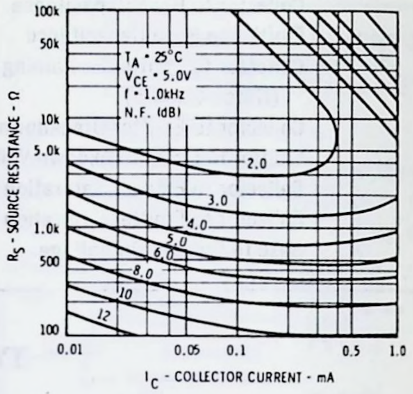
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



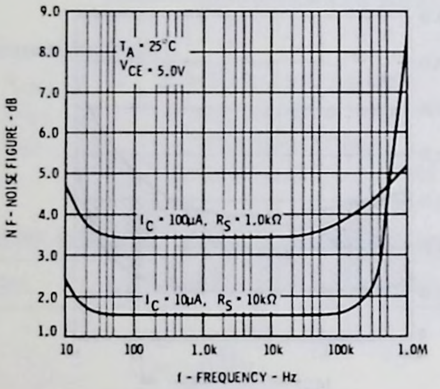
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



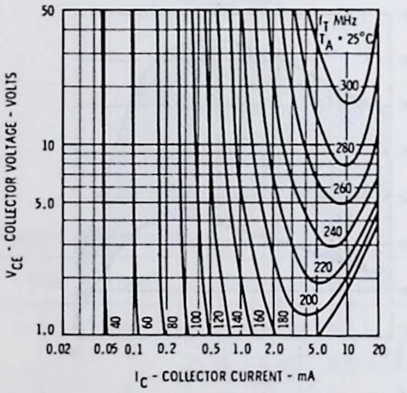
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



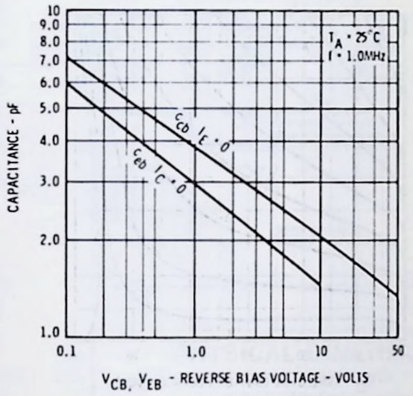
NOISE FIGURE VERSUS FREQUENCY



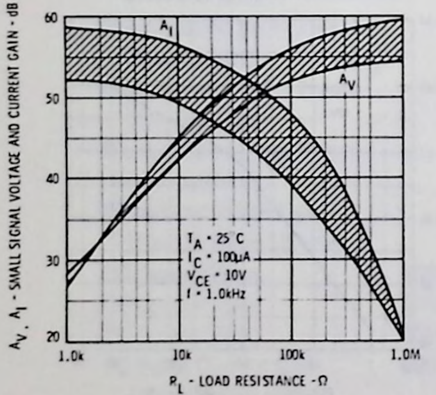
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



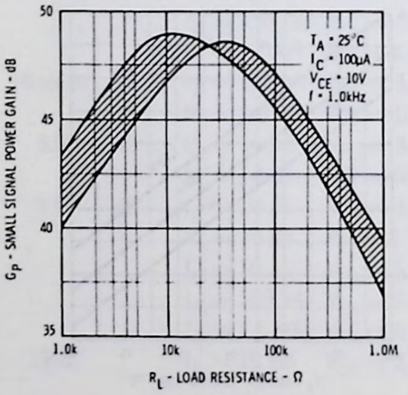
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



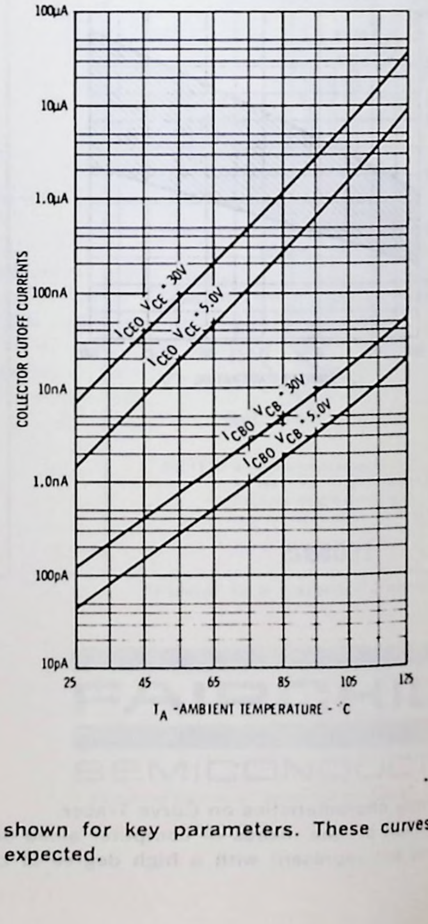
SMALL SIGNAL VOLTAGE AND CURRENT GAIN VERSUS LOAD RESISTANCE**



SMALL SIGNAL POWER GAIN VERSUS LOAD RESISTANCE**



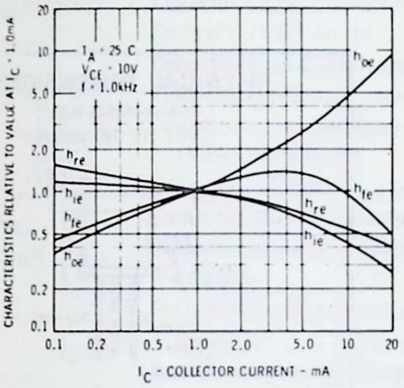
COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



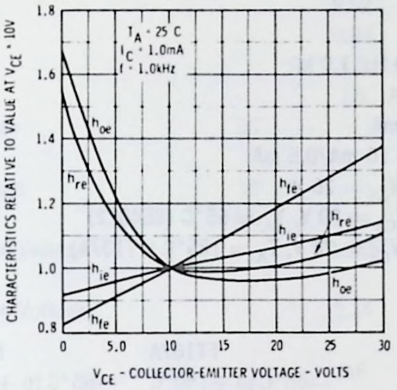
** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

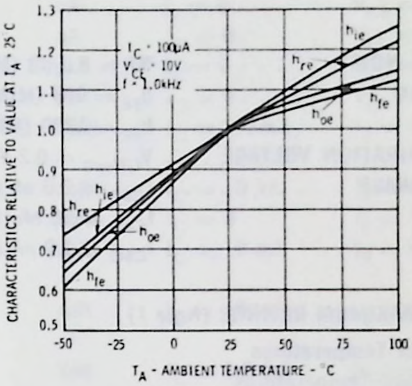
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



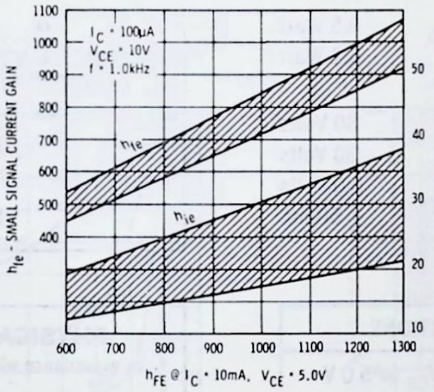
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



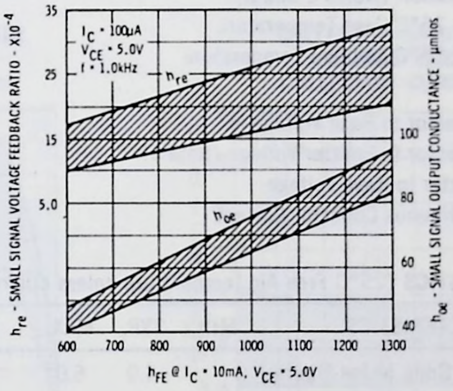
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



h PARAMETER CORRELATIONS**



h PARAMETER CORRELATIONS**



** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

ALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	28	kΩ	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{oe}	Output Conductance	74	μmhos	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{re}	Voltage Feedback Ratio	23	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain	1050		$I_C = 1.0$ mA	$V_{CE} = 10$ V

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction to ambient thermal resistance of 480°C/Watt (derating factor of 2.1 mW/°C) for FT107B. A maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C) for SE4021.

This rating refers to a high current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

Normally >90% of the units will have NF less than 11 dB.

FT107A • SE4022

NPN LOW LEVEL, LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **LOW 1/f NOISE** . . . . **NF = 8.0 dB (MAX) AT 10 Hz, 1.0 kΩ**
- **HIGH GAIN** . . . . **h_{FE} = 900 (MIN) AT 10 μA**
  h_{FE} = 1200 (MIN) AT 10 mA
- **LOW SATURATION VOLTAGE** . . . **$V_{CE(sat)}$ = 0.2 V (MAX) AT 10 mA/0.5 mA**
- **LOW LEAKAGE** . . . . **I_{CBO} = 2.0 nA (MAX) AT V_{CB} = 20 V**
  I_{CBO} = 50 nA (MAX) AT V_{CB} = 20 V, T_A = 65°C (SE4022)
  I_{CBO} = 1.0 μA (MAX) AT V_{CB} = 20 V, T_A = 125°C (FT107A)

ABSOLUTE MAXIMUM RATINGS (Note 1)

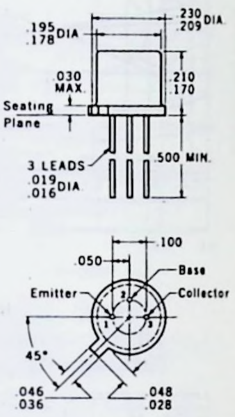
		FT107A	SE4022
Maximum Temperatures			
Storage Temperatures		−65°C to +150°C	−65°C to +125°C
Operating Junction Temperatures		+150°C	+125°C
Lead Temperature (Soldering, 10 seconds time limit)		+300°C	+260°C
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Case Temperature		0.86 Watt	0.5 Watt
25°C Ambient Temperature		0.26 Watt	0.2 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage	30 Volts	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	30 Volts
V_{EBO}	Emitter to Base Voltage	8.0 Volts	8.0 Volts
I_C	Continuous Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	Narrow Band Noise Figure (f = 1.0 kHz)		4.0	6.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 1.0 kΩ BW = 400 Hz
NF	Narrow Band Noise Figure (f = 1.0 kHz)		1.0	3.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 10 kΩ BW = 400 Hz
NF	Narrow Band Noise Figure (f = 1.0 kHz)		2.0	6.0	dB	I_C = 100 μA V_{CE} = 5.0 V R_S = 100 kΩ BW = 400 Hz
NF	**Narrow Band Noise Figure (f = 10 Hz)**		**5.0**	**8.0**	**dB**	**I_C = 100 μA V_{CE} = 5.0 V R_S = 1.0 kΩ BW = 10 Hz**
h_{FE}	**DC Current Gain**	**900**	**1100**			**I_C = 10 μA V_{CE} = 5.0 V**
h_{FE}	DC Current Gain	1000	1580			I_C = 100 μA V_{CE} = 5.0 V
h_{FE}	DC Current Gain	1200	1735			I_C = 1.0 mA V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**1200**	**1540**	**2200**		**I_C = 10 mA V_{CE} = 5.0 V**
h_{FE}(−55°C)	DC Current Gain	300				I_C = 10 μA V_{CE} = 5.0 V
h_{FE}(100°C)	DC Pulse Current Gain (Note 5) (FT107A)		2140	3300		I_C = 10 mA V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0	2.8			I_C = 10 mA V_{CE} = 5.0 V

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline

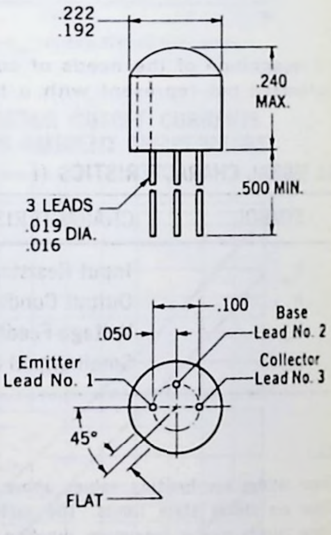


NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.43 gram

FT107A

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-106) outli



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

SE4022

*Planar is a patented Fairchild proces

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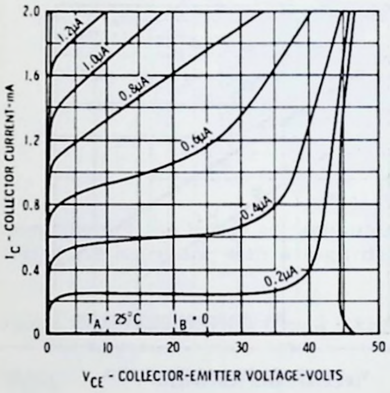
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

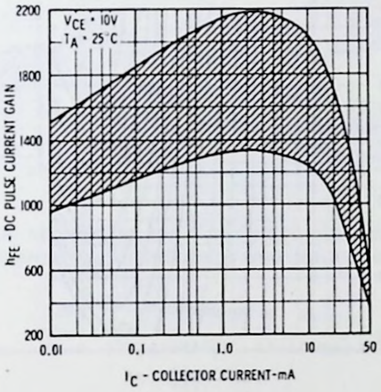
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	**Collector Cutoff Current**		**0.02**	**2.0**	**nA**	**$I_E = 0$**	**$V_{CB} = 20$ V**
I_{CBO}(65°C)	**Collector Cutoff Current (SE4022)**		**0.3**	**50**	**nA**	**$I_E = 0$**	**$V_{CB} = 20$ V**
I_{CBO}(125°C)	**Collector Cutoff Current (FT107A)**		**0.02**	**1.0**	**μA**	**$I_E = 0$**	**$V_{CB} = 20$ V**
I_{EBO}	Emitter Cutoff Current		0.03	1.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{cb}	Collector Base Capacitance		2.5	4.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
C_{eb}	Emitter Base Capacitance		2.9	6.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			Volts	$I_C = 5.0$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	30			Volts	$I_C = 10$ μA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0			Volts	$I_C = 0$	$I_E = 10$ μA
$V_{CE(sat)}$	**Pulsed Collector to Emitter Saturation Voltage (Note 5)**		**0.085**	**0.2**	**Volt**	**$I_C = 10$ mA**	**$I_B = 0.5$ mA**
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		0.14	0.3	Volt	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(on)}$	Base to Emitter On Voltage		0.6	0.7	Volt	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

TYPICAL ELECTRICAL CHARACTERISTICS

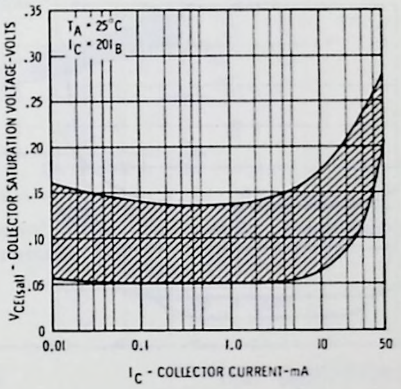
COLLECTOR CHARACTERISTICS* ACTIVE REGION



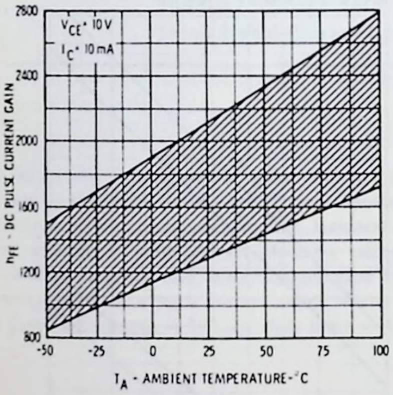
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT**



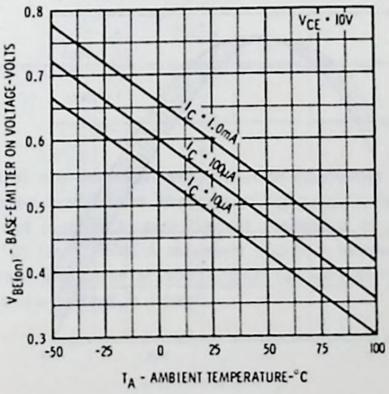
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT**



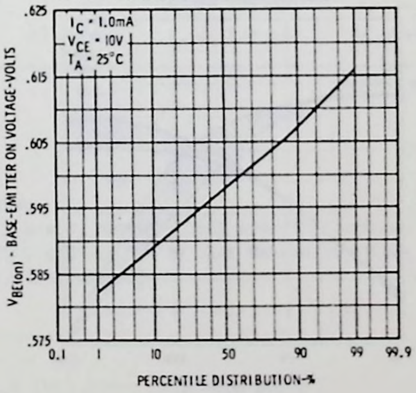
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE**



BASE-EMITTER ON VOLTAGE VERSUS AMBIENT TEMPERATURE



DISTRIBUTION OF BASE-EMITTER ON VOLTAGE**



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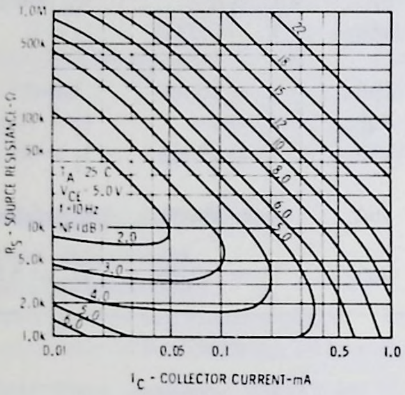
* Single family characteristics on Transistor Curve Tracer.

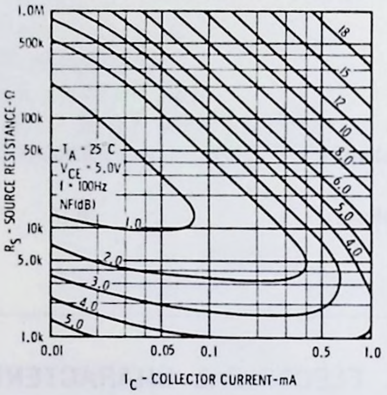
** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

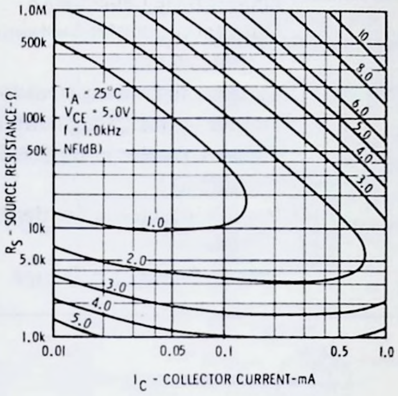
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



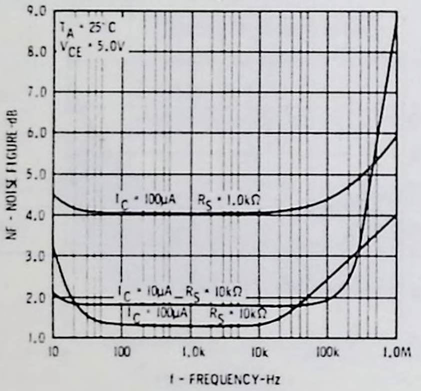
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



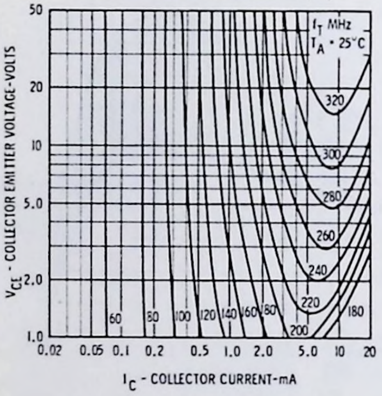
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



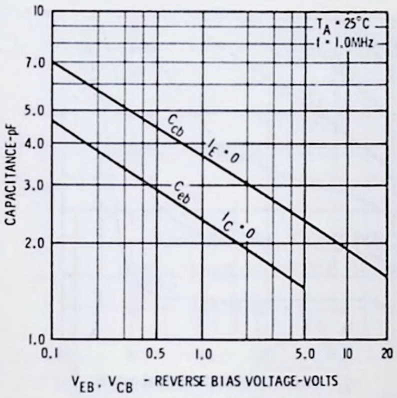
NOISE FIGURE VERSUS FREQUENCY



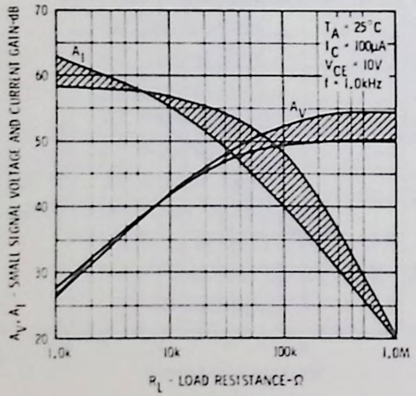
CONTOURS OF CONSTANT GAIN BANDWITH PRODUCT (f_T)



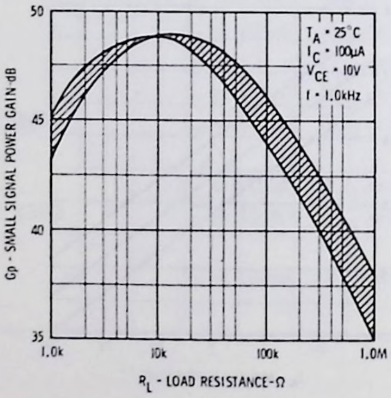
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



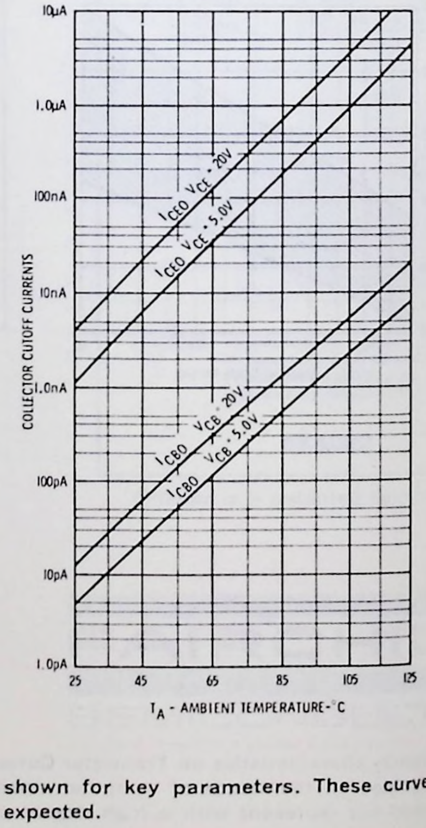
SMALL SIGNAL VOLTAGE AND CURRENT GAIN VERSUS LOAD RESISTANCE** .



SMALL SIGNAL POWER GAIN VERSUS LOAD RESISTANCE**



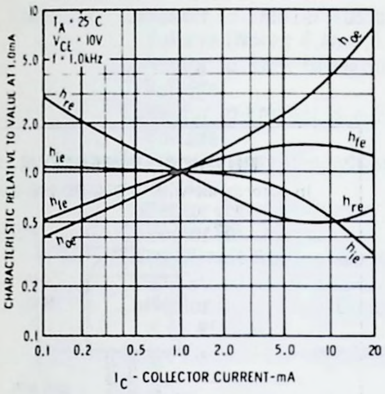
COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



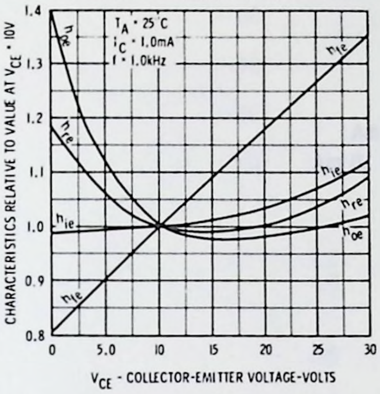
** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are no guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

TYPICAL ELECTRICAL CHARACTERISTICS

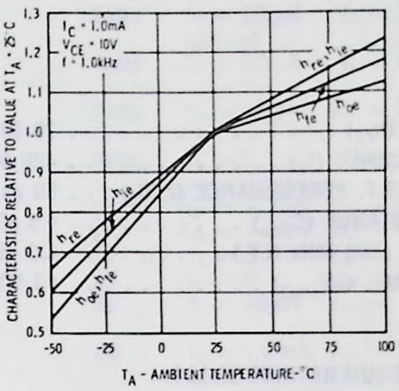
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



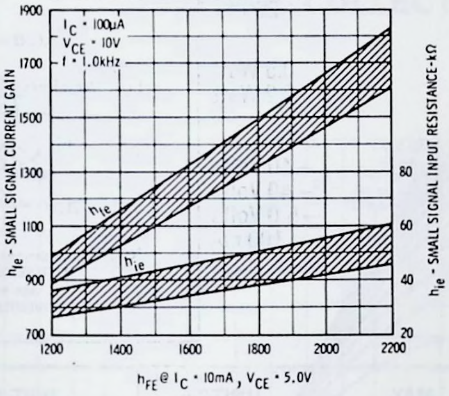
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



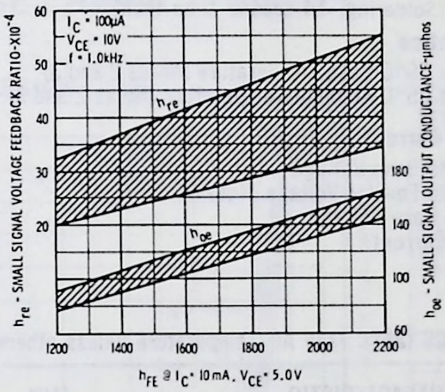
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



h PARAMETER CORRELATIONS**



h PARAMETER CORRELATIONS**



** In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

ALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	39	kohms	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{oe}	Output Conductance	120	μmhos	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{re}	Voltage Feedback Ratio	33	x10⁻⁴	$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain	1630		$I_C = 1.0$ mA	$V_{CE} = 10$ V

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 146°C/Watt (derating factor of 6.9 mW/°C); junction to ambient thermal resistance of 480°C/Watt (derating factor of 2.1 mW/°C) for FT107A. A maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 5.0 mW/°C) for SE4022.

This rating refers to a high current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N4121

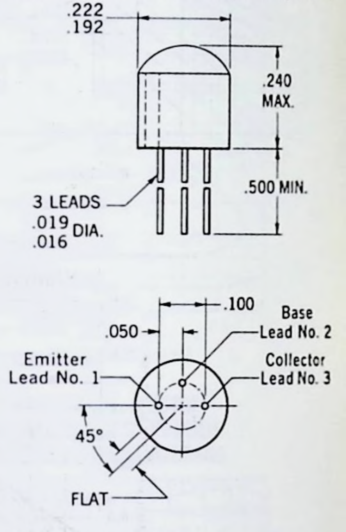
PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTOR

HIGH BETA (h_{FE})	**70 TO 200 AT 10 mA**
HIGH FREQUENCY (f_T)	**400 MHz MIN. AT 10 mA**
EXCELLENT R.F. PERFORMANCE ($r_b'C_c$)	**50 ps MAX.**
LOW CAPACITANCE (C_{obo})	**4.5 pF MAX.**
LOW NOISE (100 MHz N.F.)	**6.0 dB MAX.**
HIGH VOLTAGE (LV_{CEO})	**40 VOLTS MIN.**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.2 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	−40 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	−40 Volts
V_{EBO} Emitter to Base Voltage	−5.0 Volts
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	**DC Current Gain**	40	70			**I_c = 100 μA** V_{CE} = −1.0 V
h_{FE}	DC Current Gain	60	100			I_C = 1.0 mA V_{CE} = −1.0 V
h_{FE}	**DC Pulse Current Gain** [Note 5]	**70**	**150**	**200**		**I_C = 10 mA** V_{CE} = −1.0 V
h_{FE}	DC Pulse Current Gain [Note 5]	15	30			I_C = 50 mA V_{CE} = −1.0 V
V_{CE} (sat)	Collector Saturation Voltage		−0.07	−0.13	Volts	I_C = 1.0 mA I_B = 0.1 mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		−0.1	−0.14	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE} (sat)	**Pulsed Collector Saturation Voltage** [Note 5]		−0.2	−0.3	**Volts**	**I_C = 50 mA** I_B = 5.0 mA
V_{BE} (sat)	Base Saturation Voltage		−0.65	−0.75	Volts	I_C = 1.0 mA I_B = 0.1 mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	−0.7	−0.77	−0.9	Volts	I_C = 10 mA I_B = 1.0 mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		−0.88	−1.1	Volts	I_C = 50 mA I_B = 5.0 mA
t_{on}	**Turn On Time** [Note 6]		20	40	ns	**I_C ≈ 50 mA** I_{B1} ≈ 5.0 mA
t_{off}	**Turn Off Time** [Note 6]		95	150	ns	**I_C ≈ 50 mA** I_{B1} ≈ 5.0 mA I_{B2} ≈ −5.0 mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**4.0**	**5.5**			**I_C = 10 mA** V_{CE} = −20 V

*Planar is a patented Fairchild proce

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambie thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.
(7) Power Bandwidth of 15.7 kHz with 3 dB points at 10 Hz and 10 kHz.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

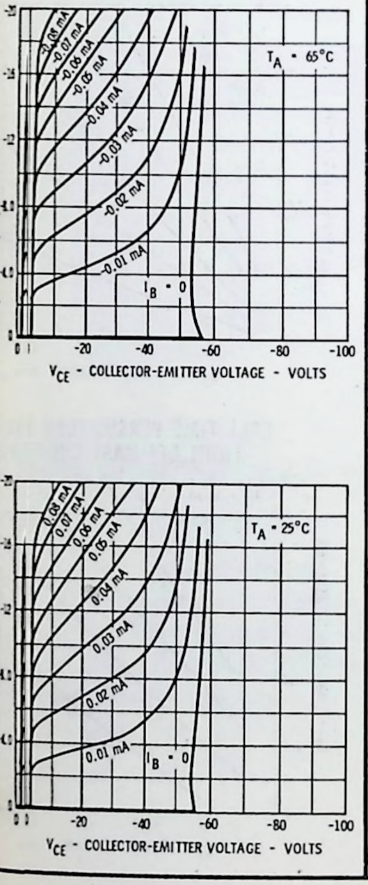
FAIRCHILD TRANSISTOR 2N4121

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

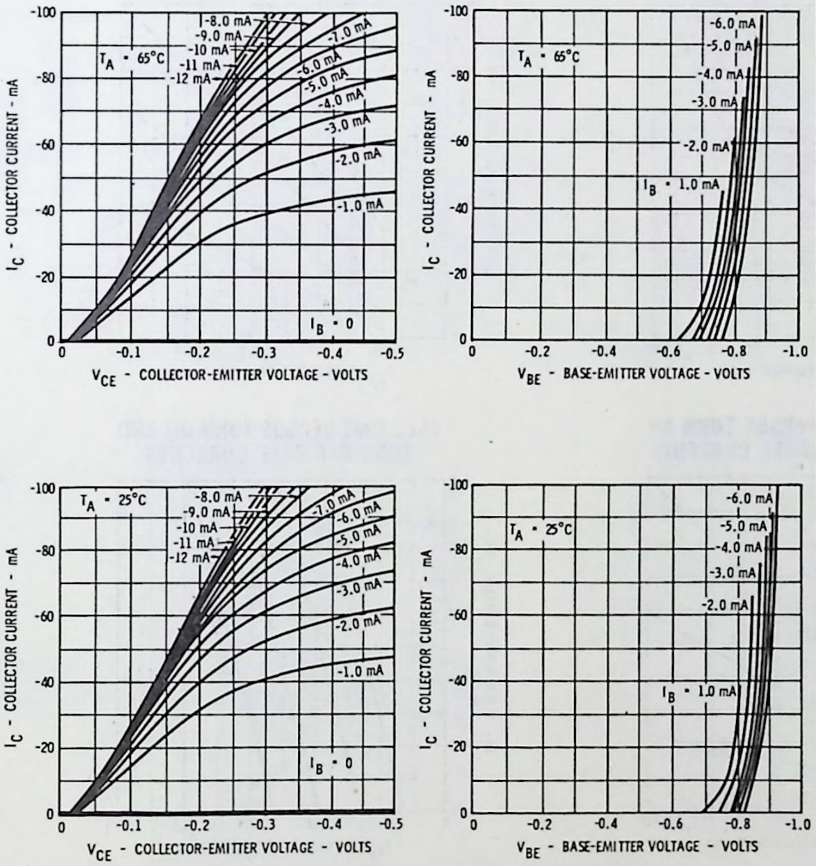
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	−40			**Volts**	**$I_C = 10$ mA** (pulsed)	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−40			Volts	$I_C = 10\ \mu A$	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−40			Volts	$I_C = 10\ \mu A$	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
I_{CES}	Collector Reverse Current			25	nA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CES} (65°C)	Collector Reverse Current			25	μA	$V_{CE} = -30$ V	$V_{BE} = 0$
C_{obo}	**Open Circuit Output Capacitance**		2.2	4.5	**pF**	$I_E = 0$	**$V_{CB} = -10$V**
C_{ibo}	Open Circuit Input Capacitance		4.0	8.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
$r_b' C_c$	**Collector-Base Time Constant (f = 80 MHz)**			50	**ps**	**$I_C = 10$ mA**	$V_{CE} = -20$ V
NF	**Noise Figure (f = 100 MHz)**		3.5	6.0	**dB**	**$I_C = 1.0$ mA** $R_S = 100\Omega$	$V_{CE} = -5.0$ V BW = 15 MHz
NF	Noise Figure [Note 7]		2.5	4.0	dB	$I_C = 100\ \mu A$ $R_S = 1.0\ k\Omega$	$V_{CE} = -5.0$ V

TYPICAL COLLECTOR AND BASE CHARACTERISTICS

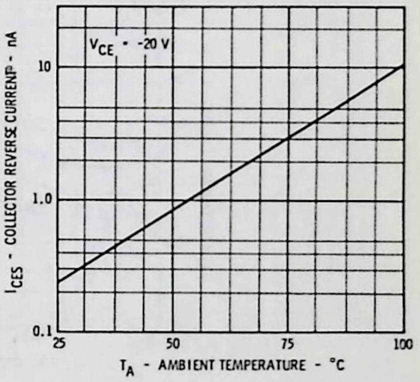
ACTIVE REGION



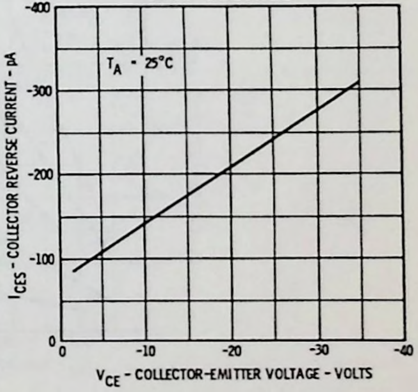
SATURATION REGION



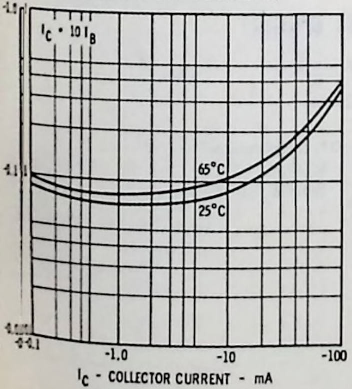
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



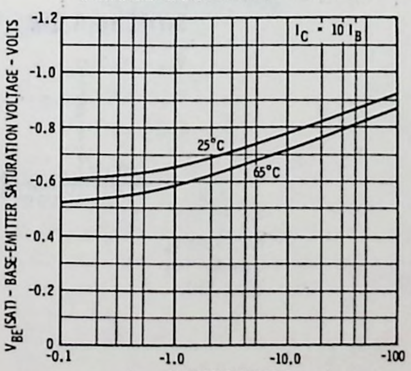
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



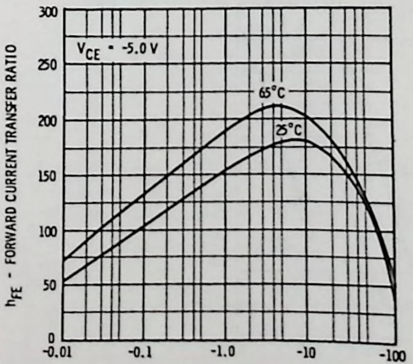
COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



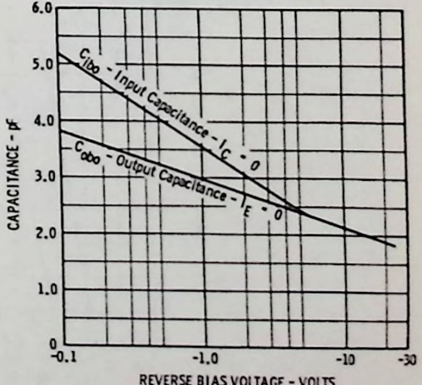
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT

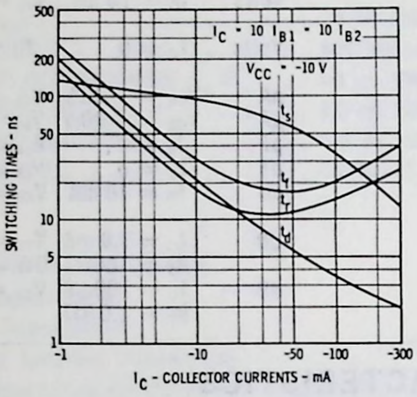


INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

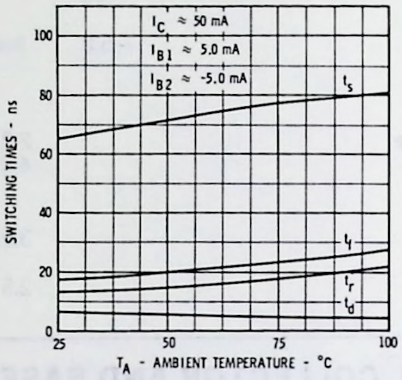


TYPICAL SWITCHING CHARACTERISTICS

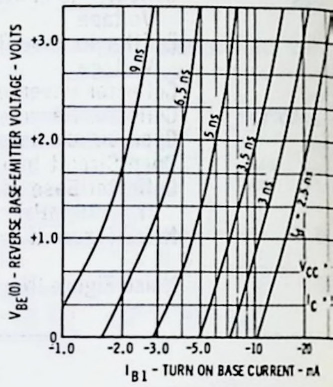
SWITCHING TIMES VERSUS COLLECTOR CURRENT



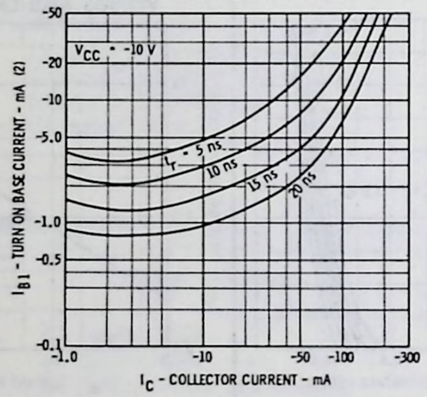
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



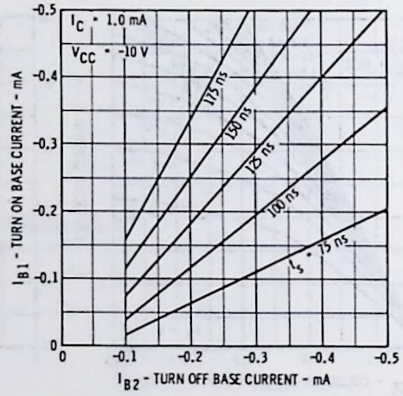
DELAY TIME VERSUS TURN
BASE CURRENT AND REVER
BASE EMITTER VOLTAGE



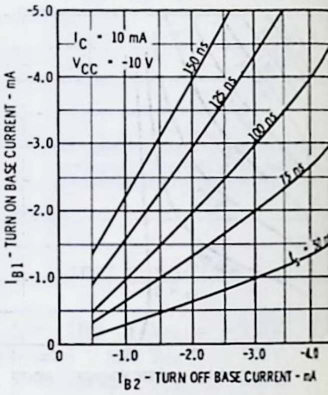
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



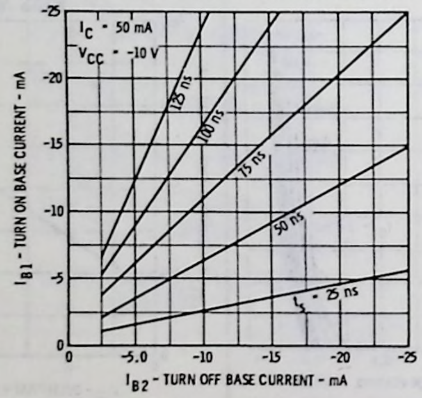
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



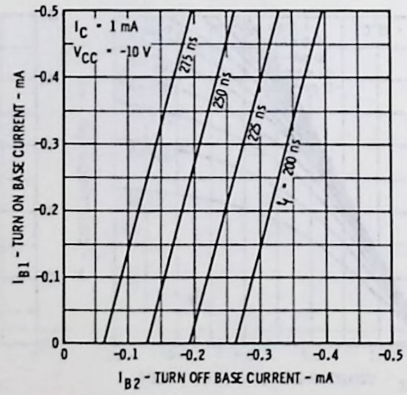
STORAGE TIME VERSUS TURN
AND TURN OFF BASE CURRE



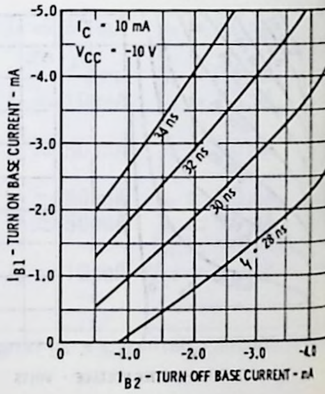
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



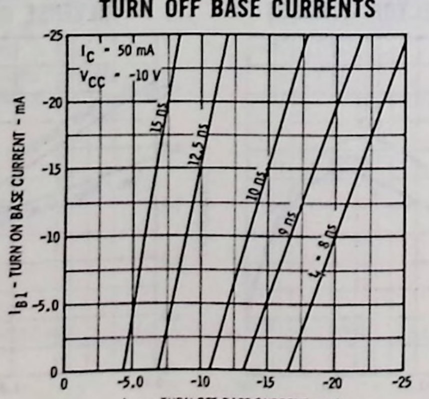
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



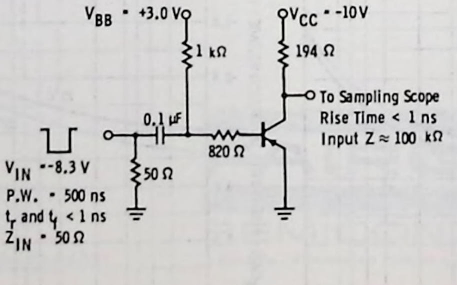
FALL TIME VERSUS TURN ON
TURN OFF BASE CURRENT



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



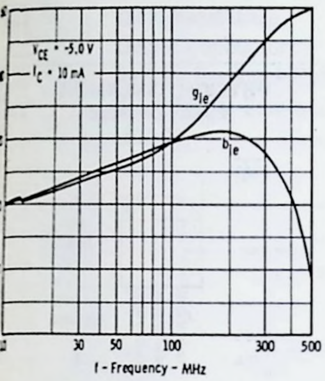
SWITCHING TIME TEST CIRCUIT


V_{BB} = +3.0 V
1 kΩ
V_{CC} = -10V
194 Ω
To Sampling Scope
Rise Time < 1 ns
Input Z ≈ 100 kΩ
0.1 µF
820 Ω
50 Ω
V_{IN} = -8.3 V
P.W. = 500 ns
t_r and t_f < 1 ns
Z_{IN} = 50 Ω

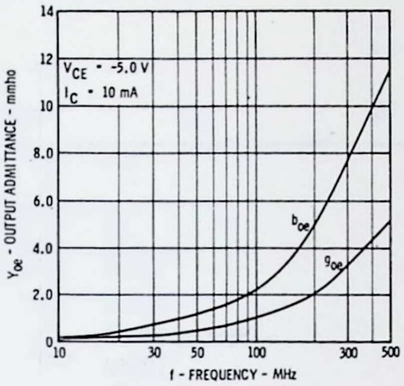
FAIRCHILD TRANSISTOR 2N4121

TYPICAL COMMON EMITTER "Y" PARAMETERS

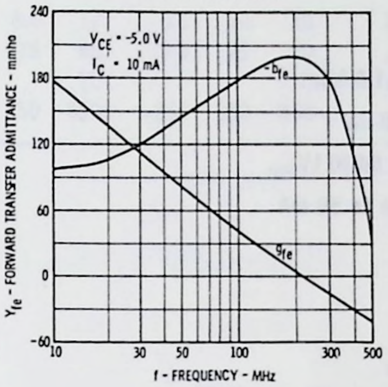
INPUT ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



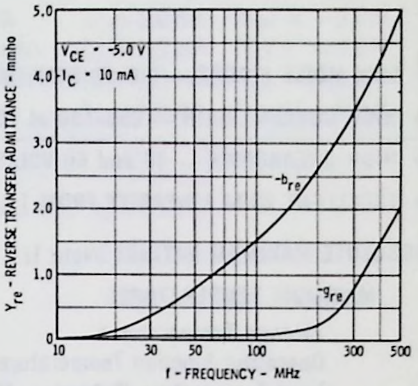
OUTPUT ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



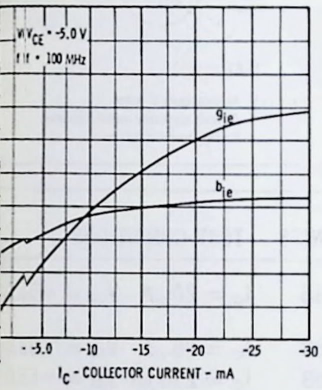
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



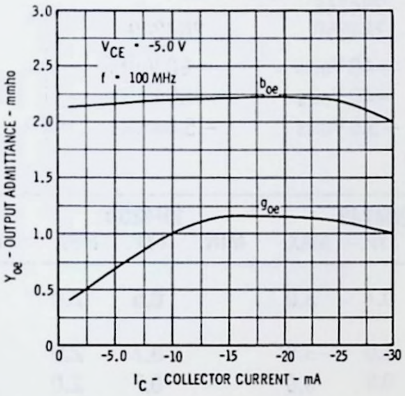
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



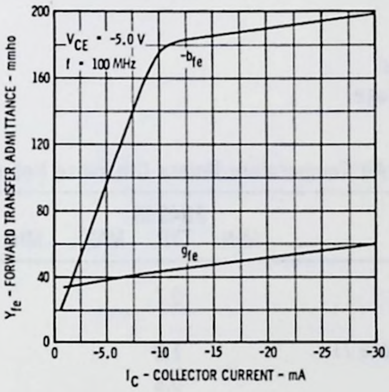
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



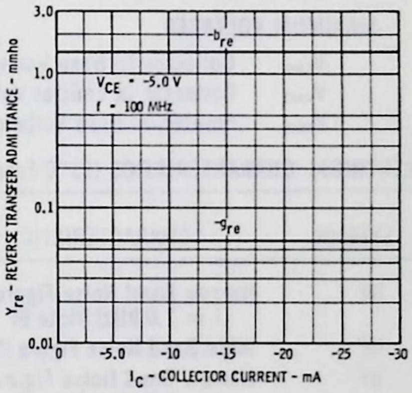
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT

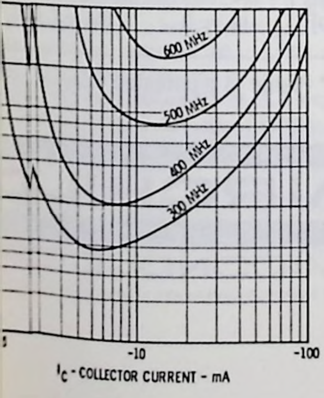


SIGNAL CHARACTERISTICS (f = 1 kHz)

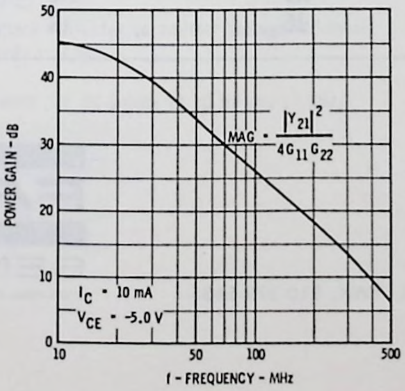
MBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
	Input Resistance	1.0	8.0	kΩ	$I_C = 1.0$ mA	$V_{CE} = -10$ V
	Output Conductance	2.0	24	μmho	$I_C = 1.0$ mA	$V_{CE} = -10$ V
	Voltage Feedback Ratio		3.0	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -10$ V
	Forward Current Transfer Ratio	50	300		$I_C = 1.0$ mA	$V_{CE} = -10$ V

TYPICAL ELECTRICAL CHARACTERISTICS

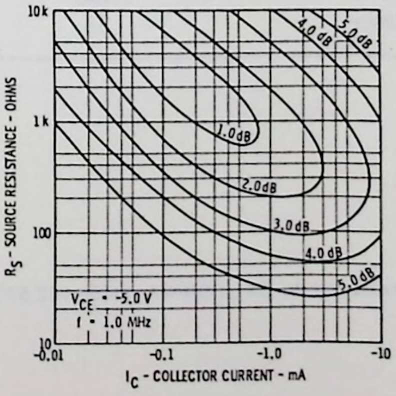
CONTOUR OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



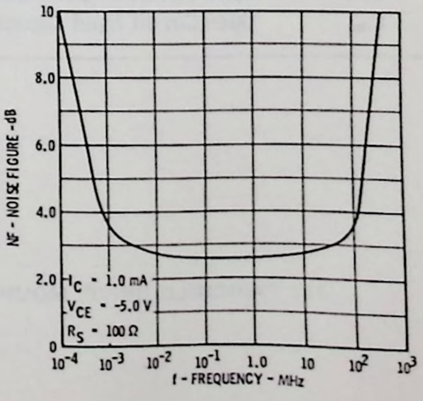
MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



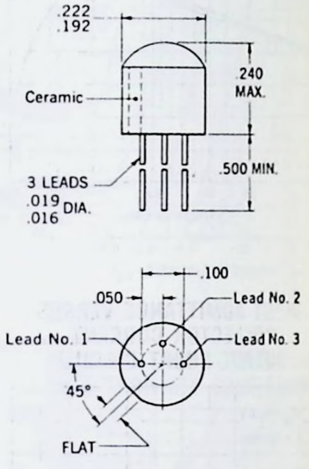
NOISE FIGURE VERSUS FREQUENCY



2N4248 • 2N4249 • 2N4250
PNP LOW LEVEL, LOW NOISE AMPLIFIER
DIFFUSED SILICON PLANAR* TRANSISTORS

- **LOW NOISE FIGURE -- 2.0 dB (MAX) at 1.0 kHz**
- **HIGH CURRENT GAIN -- 250-700 at 100 μA**
- **HIGH BREAKDOWN -- 40 and 60 VOLTS (MIN) LV_{CEO}**
- **EXCELLENT BETA LINEARITY FROM 1 μA to 50 mA**

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

MAXIMUM TEMPERATURES

Storage Temperatures	−55°C to 125°C
Operating Junction Temperatures	125°C
Lead Temperature (Soldering, 10 seconds time limit)	260°C

MAXIMUM POWER DISSIPATION

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt
25°C Ambient Temperature [Notes 2 and 3]	0.2 Watt

MAXIMUM VOLTAGES		2N4248 2N4250	2N4249
V_{CBO}	Collector to Base Voltage	−40 Volts	−60 Volts
V_{CEO}	Collector to Emitter Voltage	−40 Volts	−60 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

SYMBOL	CHARACTERISTIC	2N4248 MIN.	2N4248 TYP.	2N4248 MAX.	2N4249 MIN.	2N4249 TYP.	2N4249 MAX.	2N4250 MIN.	2N4250 TYP.	2N4250 MAX.	UNITS	TEST CONDITIONS
NF	**Narrow Band Noise Figure (f = 1.0 kHz)** [Note 6]		0.7			0.7	3.0		**0.5**	**2.0**	**dB**	**$I_C = 20\ \mu A$ $V_{CE} = -5.0V$**
NF	**Wide Band Noise Figure** [Note 7]		1.0			1.0	3.0		**0.7**	**2.0**	**dB**	**$I_C = 20\ \mu A$ $V_{CE} = -5.0V$**
NF	Narrow Band Noise Figure (f = 1.0 kHz) [Note 8]		0.8			0.8	3.0		0.7	2.0	dB	$I_C = 250\ \mu A$ $V_{CE} = -5.0V$
h_{FE}	**DC Current Gain**		90			190			**300**			**$I_C = 10\ \mu A$ $V_{CE} = -5.0V$**
h_{FE}	**DC Current Gain**	50	100		100	240	300	**250**	**350**	**700**		**$I_C = 100\ \mu A$ $V_{CE} = -5.0V$**
h_{FE}	DC Current Gain	50	110		100	250		250	350			$I_C = 1.0\ mA$ $V_{CE} = -5.0V$
h_{FE}	**DC Pulse Current Gain** [Note 5]	50	120		100	280		**250**	**350**			**$I_C = 10\ mA$ $V_{CE} = -5.0V$**
BV_{CBO}	Collector to Base Breakdown Voltage	−40			−60			−40			Volts	$I_C = 10\ \mu A$ $I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−40			−60			−40			Volts	$I_C = 10\ \mu A$
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	−40			−60			**−40**			**Volts**	**$I_C = 5.0\ mA$** (pulsed) $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			−5.0			Volts	$I_C = 0$ $I_E = 10\ \mu A$
I_{CBO}	**Collector Cutoff Current**			10			10			**10**	**nA**	**$I_E = 0$ $V_{CB} = -40V$**
I_{CBO} (65°C)	Collector Cutoff Current			3.0			3.0			3.0	μA	$I_E = 0$ $V_{CB} = -40V$
I_{EBO}	Emitter Cutoff Current			20			20			20	nA	$I_C = 0$ $V_{BE} = 3.0\ V$
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]			−0.25			−0.25			−0.25	Volts	$I_C = 10\ mA$ $I_B = 0.5\ mA$
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]			−0.9			−0.9			−0.9	Volts	$I_C = 10\ mA$ $I_B = 0.5\ mA$
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50			100	250	550	250	350	800		$I_C = 1.0\ mA$ $V_{CE} = -5.0V$
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0			2.0			2.5				$I_C = 0.5\ mA$ $V_{CE} = -5.0V$
C_{obo}	Open Circuit Output Capacitance			6.0			6.0			6.0	pF	$I_E = 0$ $V_{CB} = -5.0V$
C_{ibo}	Open Circuit Input Capacitance			16			16			16	pF	$I_C = 0$ $V_{BE} = 0.5\ V$

* Planar is a patented Fairchild pro

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATIO

SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

SYMBOL	CHARACTERISTIC	2N4249 MIN.	2N4249 TYP.	2N4249 MAX.	2N4250 MIN.	2N4250 TYP.	2N4250 MAX.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	2.5	8.0	17	6.0	10	20	kΩ	$I_C = 1.0$ mA $V_{CE} = -5.0$ V
h_{oe}	Output Conductance	5.0	19	40	5.0	25	50	μmho	$I_C = 1.0$ mA $V_{CE} = -5.0$ V
h_{re}	Voltage Feedback Ratio			10			10	x10^{-4}	$I_C = 1.0$ mA $V_{CE} = -5.0$ V
h_{fe}	Small Signal Current Gain	100	250	550	250	350	800		$I_C = 1.0$ mA $V_{CE} = -5.0$ V

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low-duty cycle operations.
These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500 °C/Watt (derating factor of 2.0 mW/°C).
This rating refers to a high-current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.
R_S = 10 kΩ, Power Bandwidth of 150 Hz.
R_S = 10 kΩ, Power Bandwidth of 15.7 kHz with 3.0 dB points at 10 Hz and 10 kHz.
R_S = 1.0 kΩ, Power Bandwidth of 150 Hz.

2N4257 · 2N4258

PNP ULTRA HIGH-SPEED LOGIC SWITCHES

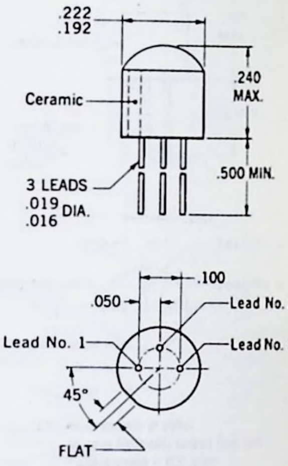
SILICON PLANAR* EPITAXIAL TRANSISTORS

FEATURES

- **LOW STORAGE TIME — $\tau_s = 20$ ns (Max).**
- **LOW CAPACITANCE — $C_{obo} = 3.0$ pF (Max), $C_{ibo} = 3.5$ pF (Max).**
- **HIGH FREQUENCY — $f_T = 700$ MHz (Min).**
- **LOW SATURATION VOLTAGE — V_{CE} (sat) $= -0.15$ V (Max) @ $I_C = 10$ mA**

* Planar is a patented Fairchild process.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 seconds time limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperatures [Notes 2 and 3]	0.5 Watt
at 25°C Free Air Temperature [Notes 2 and 3]	0.2 Watt

Maximum Voltages

		2N4257	**2N4258**
V_{CBO}	Collector to Base Voltage	−6.0 Volts	−12 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−6.0 Volts	−12 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts	−4.5 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4257 MIN.	2N4257 TYP.	2N4257 MAX.	**2N4258** MIN.	**2N4258** TYP.	**2N4258** MAX.	UNITS	TEST CONDITIONS
τ_s	**Charge Storage Time** [Note 6]		11	15		**13**	**20**	ns	$I_C \approx 10$ mA $I_{B1} \approx 10$ mA $I_{B2} \approx -10$ mA
t_{on}	**Turn On Time** [Note 6]		9.0	15		**9.0**	**15**	ns	$I_C \approx 10$ mA $I_{B1} \approx 1.0$ mA
t_{off}	**Turn Off Time** [Note 6]		12	15		**14**	**20**	ns	$I_C \approx 10$ mA $I_{B1} \approx 1.0$ mA $I_{B2} \approx -1.0$ m
h_{fe}	High Frequency Current Gain (f = 100 MHz)	5.0	11						$I_C = 10$ mA $V_{CE} = -5.0$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**				**7.0**	**13**			$I_C = 10$ mA $V_{CE} = -10$ V
C_{obo}	**Common Base, Open Circuit Output Capacitance**		2.0	3.0		**2.0**	**3.0**	pF	$V_{CB} = -5.0$ V $I_E = 0$
C_{ibo}	**Common Base, Open Circuit Input Capacitance**		2.4	3.5		**2.4**	**3.5**	pF	$I_C = 0$ $V_{EB} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	15	40		15	40			$I_C = 1.0$ mA $V_{CE} = -0.5$ V
h_{FE}	**DC Pulse Current Gain** [Note 5]	30	67	120	**30**	**67**	**120**		$I_C = 10$ mA $V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	80		30	80			$I_C = 50$ mA $V_{CE} = -1.0$ V
V_{CE} (sat)	**Pulsed Collector Saturation Voltage** [Note 5]		−0.08	−0.15		**−0.08**	**−0.15**	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		−0.2	−0.5		−0.2	−0.5	Volts	$I_C = 50$ mA $I_B = 5.0$ mA

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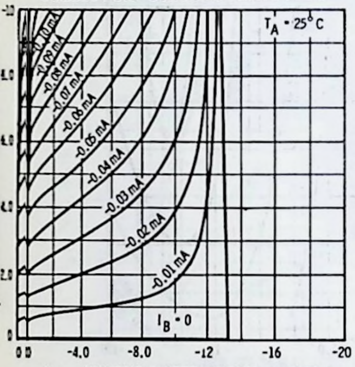
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4257 MIN.	2N4257 TYP.	2N4257 MAX.	2N4258 MIN.	2N4258 TYP.	2N4258 MAX.	UNITS	TEST CONDITIONS	
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	−0.8	−0.88	−0.95	−0.8	−0.88	−0.95	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		−1.16	−1.5		−1.16	−1.5	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CES}	Collector Reverse Current		0.02	10				nA	$V_{CE} = -3.0$ V	$V_{BE} = 0$
I_{CES}	Collector Reverse Current					0.02	10	nA	$V_{CE} = -6.0$ V	$V_{BE} = 0$
I_{CES} (+65°C)	Collector Reverse Current		0.3	5.0				μA	$V_{CE} = -3.0$ V	$V_{BE} = 0$
I_{CES} (+65°C)	Collector Reverse Current					0.5	5.0	μA	$V_{CE} = -6.0$ V	$V_{BE} = 0$
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	−6.0			−12			Volts	**$I_C = 3.0$ mA**	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5			−4.5			Volts	$I_C = 0$	$I_E = 100$ μA
BV_{CES}	Collector to Emitter Breakdown Voltage	−6.0			−12			Volts	$I_C = 100$ μA	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−6.0			−12			Volts	$I_C = 100$ μA	$I_E = 0$

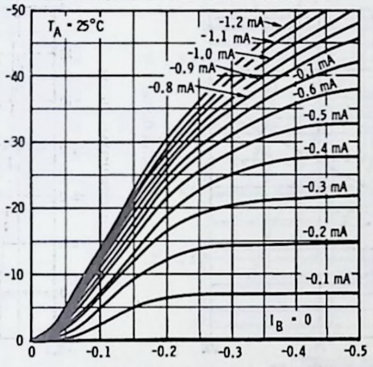
TYPICAL ELECTRICAL CHARACTERISTICS

2N4257

COLLECTOR CHARACTERISTICS*

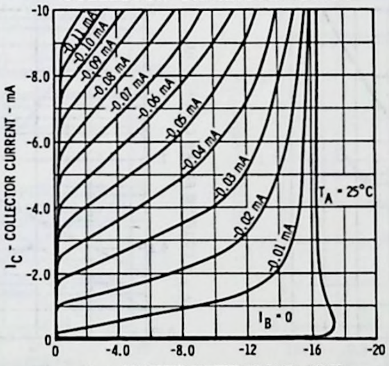


COLLECTOR CHARACTERISTICS*

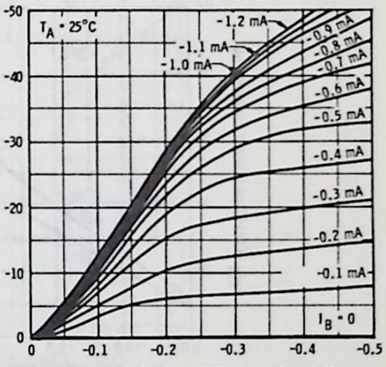


2N4258

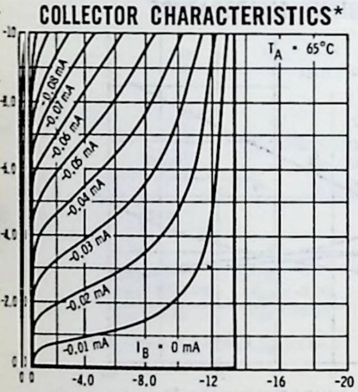
COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS*



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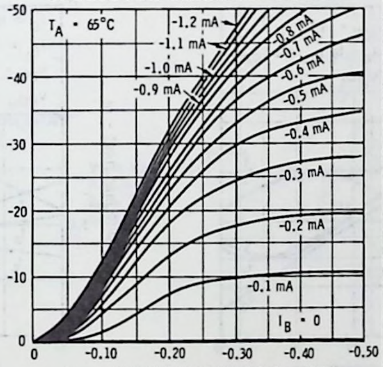

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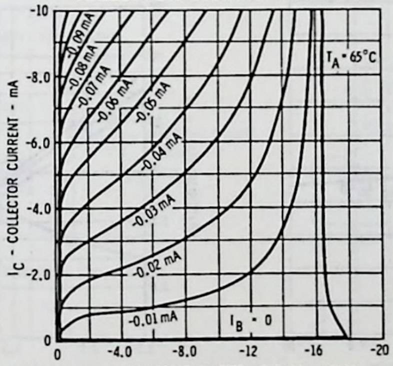
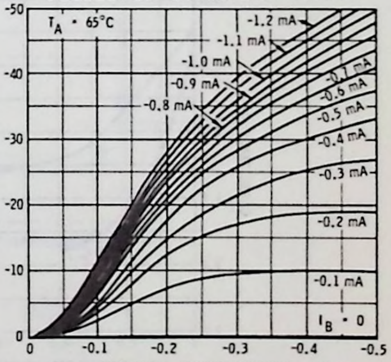
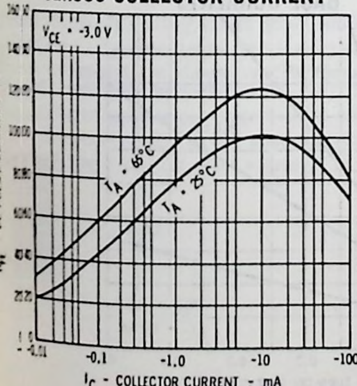


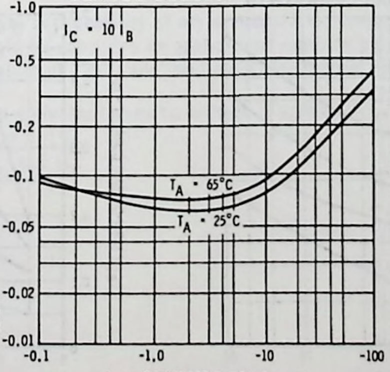
COLLECTOR CHARACTERISTICS*



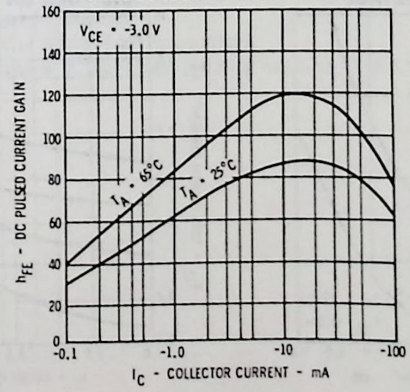
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



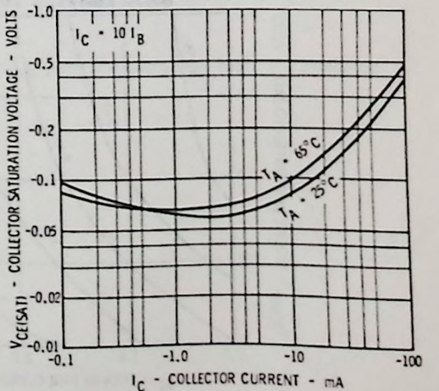
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



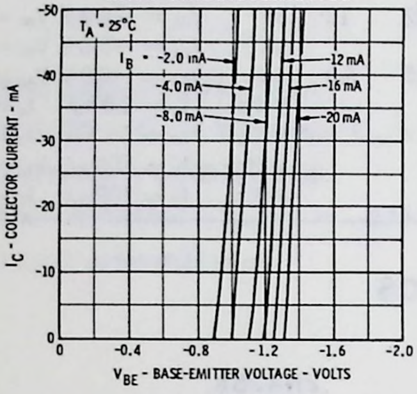
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



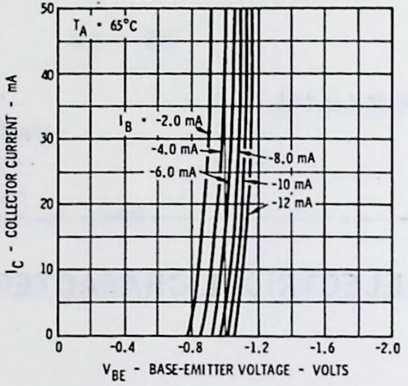
Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

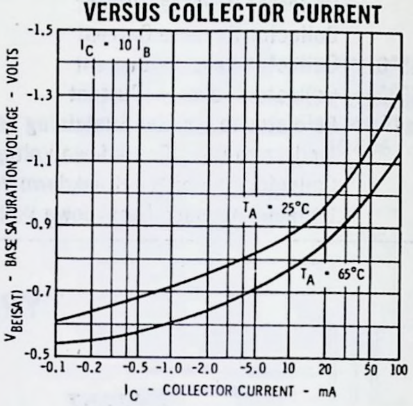
BASE CHARACTERISTICS*



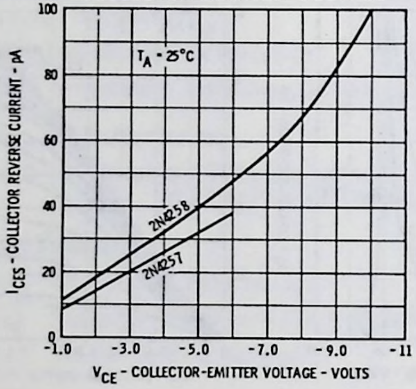
BASE CHARACTERISTICS*



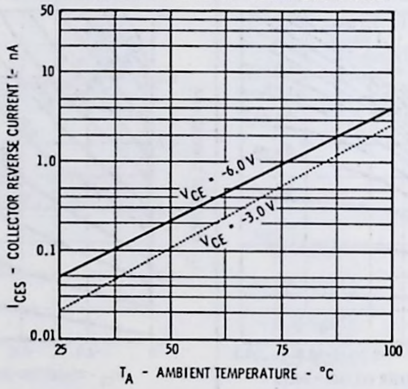
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



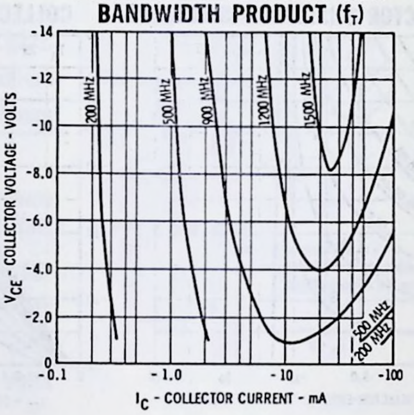
COLLECTOR REVERSE CURRENT VERSUS COLLECTOR-EMITTER VOLTAGE



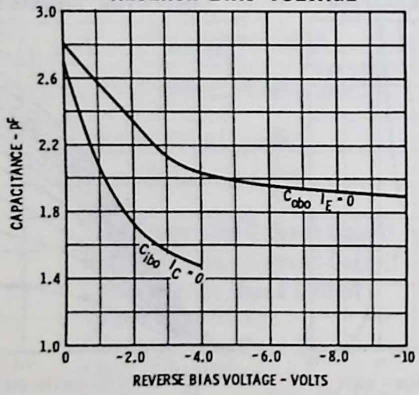
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



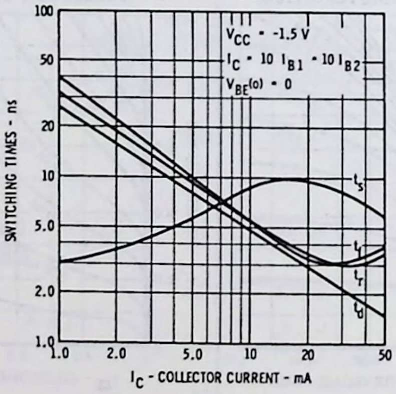
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



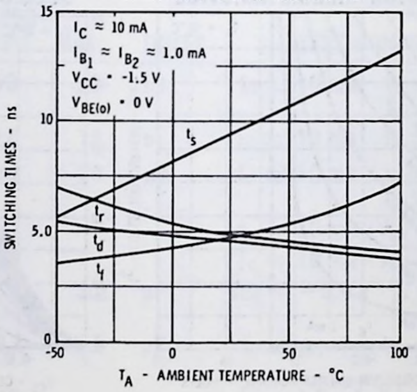
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



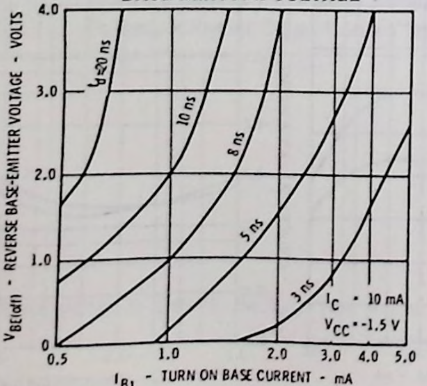
SWITCHING TIMES VERSUS COLLECTOR CURRENT



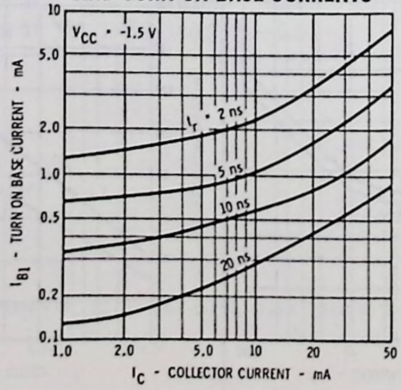
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



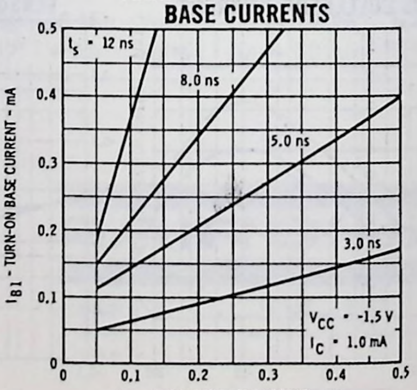
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



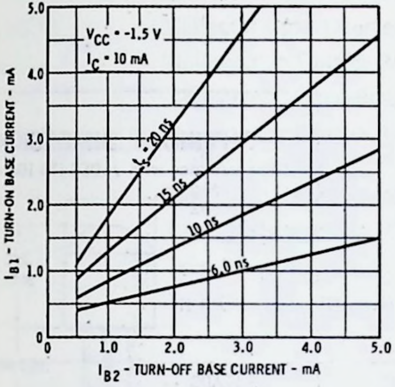
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



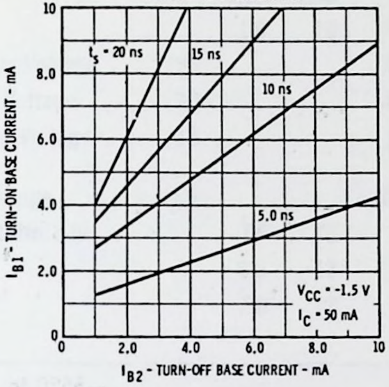
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

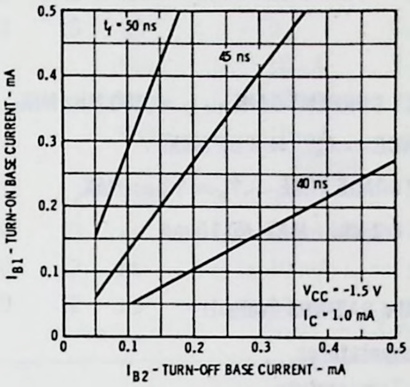
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



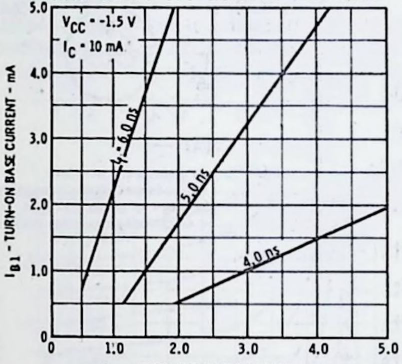
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



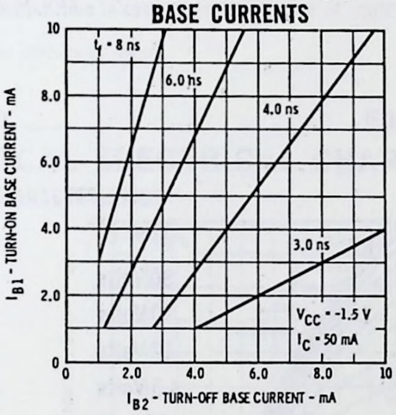
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



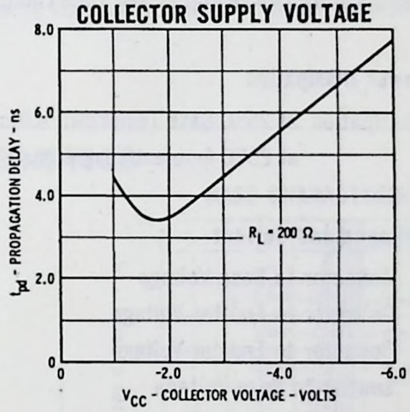
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



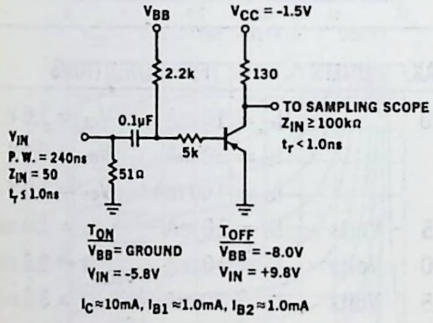
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



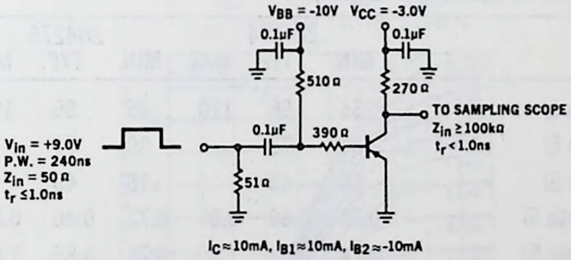
PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



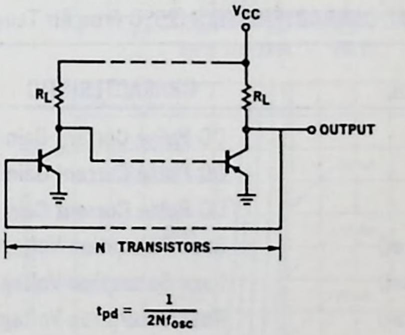
TURN ON AND TURN OFF TEST CIRCUIT


VBB
VCC = -1.5V
2.2k
130
TO SAMPLING SCOPE
ZIN ≥ 100kΩ
tr < 1.0ns
0.1μF
5k
VIN
P. W. = 240ns
ZIN = 50
tr ≤ 1.0ns
51Ω
TON
VBB = GROUND
VIN = -5.8V
TOFF
VBB = -8.0V
VIN = +9.8V
IC ≈ 10mA, IB1 ≈ 1.0mA, IB2 ≈ 1.0mA

CHARGE STORAGE TIME TEST CIRCUIT


VBB = -10V
VCC = -3.0V
0.1μF
0.1μF
510Ω
270Ω
TO SAMPLING SCOPE
Zin ≥ 100kΩ
tr < 1.0ns
Vin = +9.0V
P.W. = 240ns
Zin = 50Ω
tr ≤ 1.0ns
0.1μF
390Ω
51Ω
IC ≈ 10mA, IB1 ≈ 10mA, IB2 ≈ -10mA

FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY


VCC
RL
RL
OUTPUT
N TRANSISTORS
tpd = 1 / 2Nfosc

TES:

These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).

This rating refers to a high-current point where collector-to-emitter voltage is lowest.

Pulse Conditions: length = 300 μsec; duty cycle = 1%.

See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

2N4274 • 2N4275

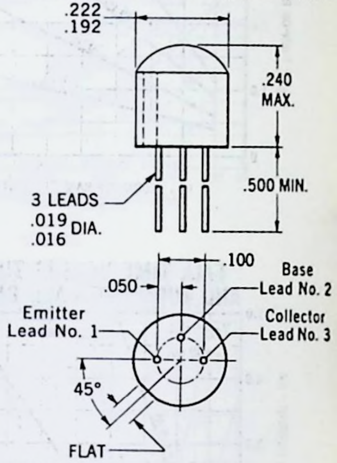
NPN HIGH-SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH FREQUENCY CURRENT GAIN - - f_T = 400 MHz MIN.**
- **LOW CAPACITANCE - - C_{obo} = 4 pF MAX.**
- **LOW CHARGE STORAGE TIME - - τ_s = 13 ns MAX.**
- **LOW V_{CE}(sat) - - 0.2 VOLT MAX. @ 10 mA**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	125°C Maximum
Lead Temperature (Soldering: 10 sec Time Limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature	0.2 Watt

Maximum Voltages and Current		2N4274	2N4275
V_{CBO}	Collector to Base Voltage	30 Volts	40 Volts
V_{CES}	Collector to Emitter Voltage	30 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage	12 Volts	15 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts	4.5 Volts
I_C	Collector Current (10 μs Pulse)	500 mA	500 mA
I_C	DC Collector Current	100 mA	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4274 MIN.	2N4274 TYP.	2N4274 MAX.	2N4275 MIN.	2N4275 TYP.	2N4275 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	35	66	120	35	66	120		I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	71		30	71			I_C = 30 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	18	45		18	45			I_C = 100 mA	V_{CE} = 1.0 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)	0.72	0.80	0.85	0.72	0.80	0.85	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)	0.74	0.85	1.00	0.74	0.85	1.00	Volts	I_C = 10 mA	I_B = 3.3 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.90	1.15		0.90	1.15	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		1.10	1.60		1.10	1.60	Volts	I_C = 100 mA	I_B = 10 mA
V_{CE} (sat)	**Collector Saturation Voltage** (Note 5)		**0.14**	**0.20**		**0.14**	**0.20**	**Volts**	**I_C = 10 mA**	**I_B = 1.0 mA**
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.12	0.18		0.12	0.18	Volts	I_C = 10 mA	I_B = 3.3 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.17	0.25		0.17	0.25	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{CE} (sat) (65°C)	Collector Saturation Voltage (Note 5)		0.19	0.30		0.19	0.30	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.28	0.50		0.28	0.50	Volts	I_C = 100 mA	I_B = 10 mA

* Planar is a patented Fairchild proce

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS 2N4274 • 2N4275

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4274 MIN.	2N4274 TYP.	2N4274 MAX.	2N4275 MIN.	2N4275 TYP.	2N4275 MAX.	UNITS	TEST CONDITIONS	
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**4.0**	**6.75**		**4.0**	**6.75**			**$I_C = 10$ mA**	**$V_{CE} = 10$ V**
C_{obo}	**Output Capacitance**		**2.3**	**4.0**		**2.3**	**4.0**	**pF**	**$I_E = 0$**	**$V_{CB} = 5.0$ V**
I_{CES}	Collector Reverse Current		0.05	0.40		0.05	0.40	μA	$V_{CE} = 20$ V	$V_{BE} = 0$
I_{CBO} (65°C)	Collector Cutoff Current		1.0	10		1.0	10	μA	$I_E = 0$	$V_{CB} = 20$ V
BV_{CES}	Collector to Emitter Breakdown Voltage	30			40			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30			40			Volts	$I_C = 10$ μA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	12			15			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			4.5			Volts	$I_C = 0$	$I_E = 10$ μA
τ_s	**Charge Storage Time Constant** (Note 6)		**7.0**	**13**		**7.0**	**13**	**ns**	**$I_C = I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA**	
t_{on}	Turn On Time (Note 6)		8.0	12		8.0	12	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3.3$ mA	
t_{off}	Turn Off Time (Note 6)		7.0	12		7.0	12	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3.3$ mA, $I_{B2} \approx -3.3$ mA	

NOTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C). Junction to ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C.

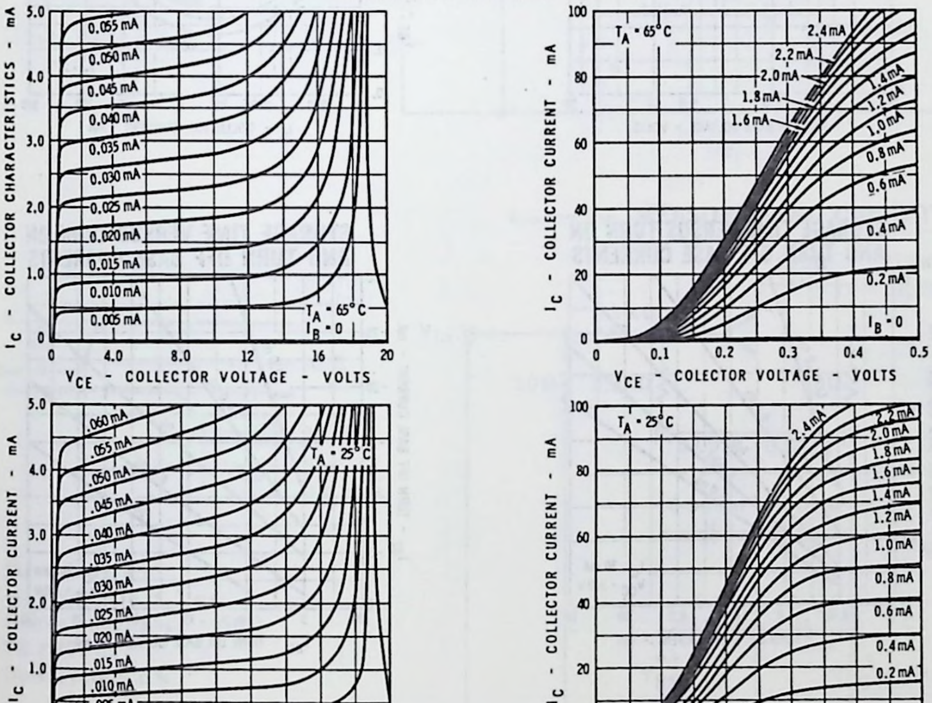
Rating refers to a high-current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

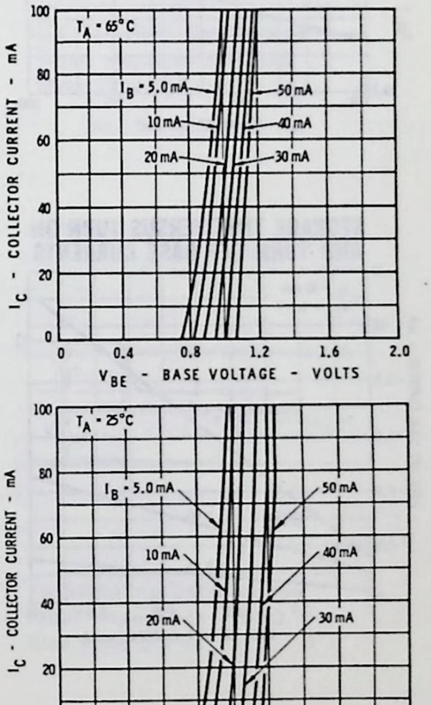
See switching circuits for exact value of I_C, I_{B1}, and I_{B2}.

TYPICAL ELECTRICAL CHARACTERISTICS

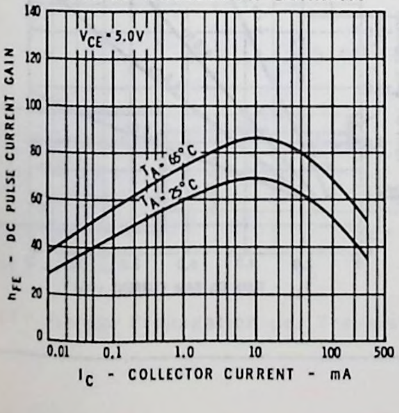
COLLECTOR CHARACTERISTICS*



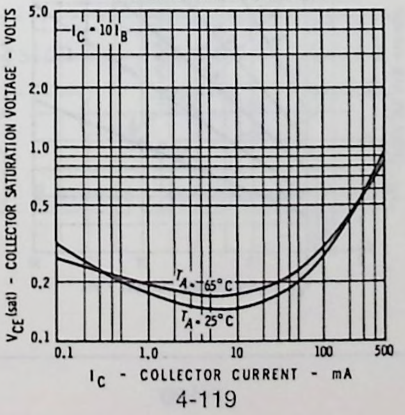
BASE CHARACTERISTICS*



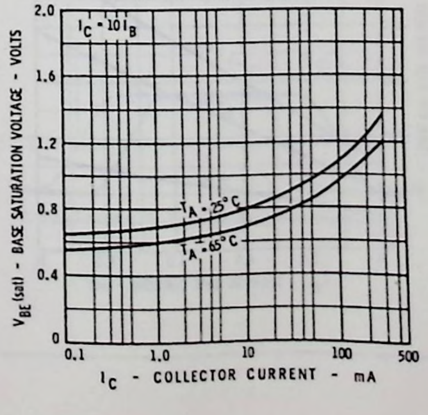
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

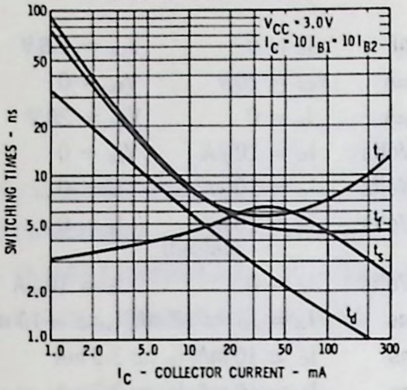


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

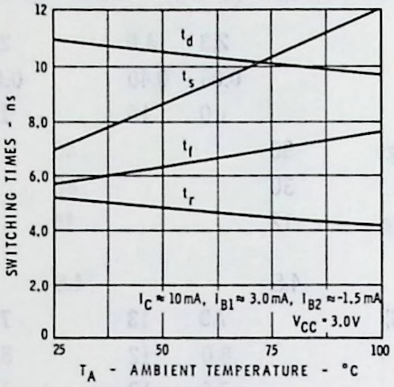


TYPICAL ELECTRICAL CHARACTERISTICS

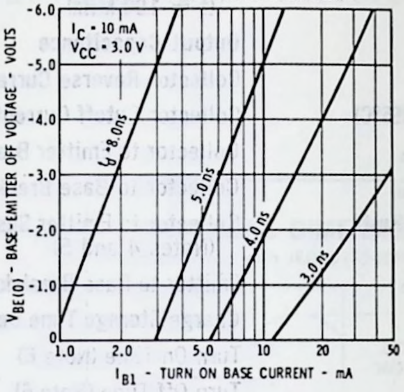
SWITCHING TIMES VERSUS COLLECTOR CURRENT



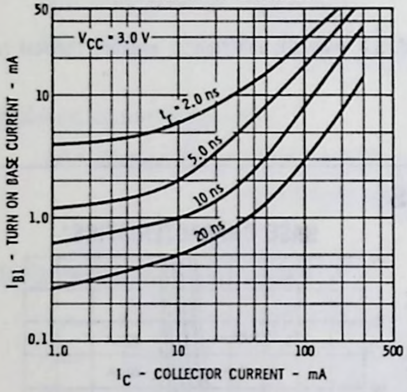
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



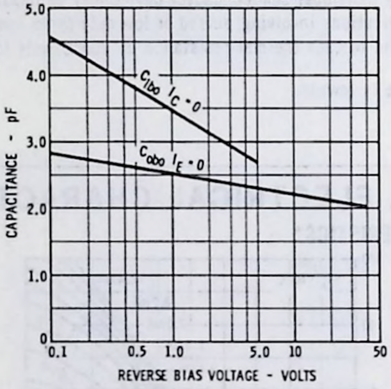
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



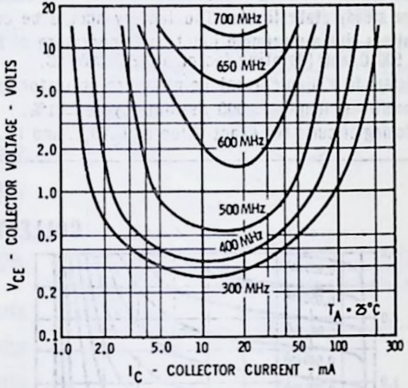
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



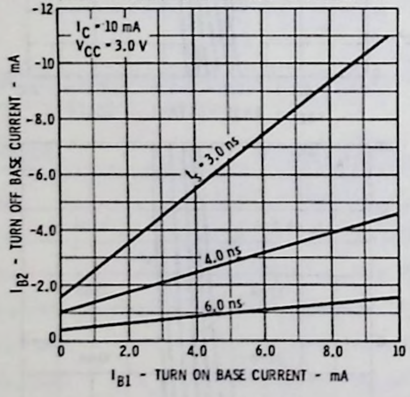
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



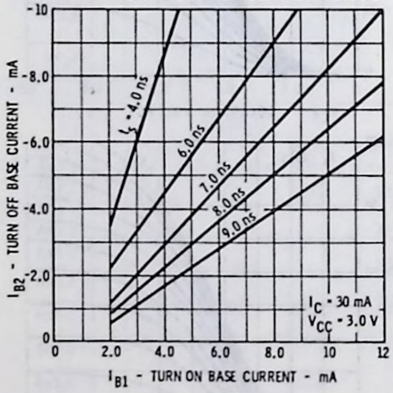
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



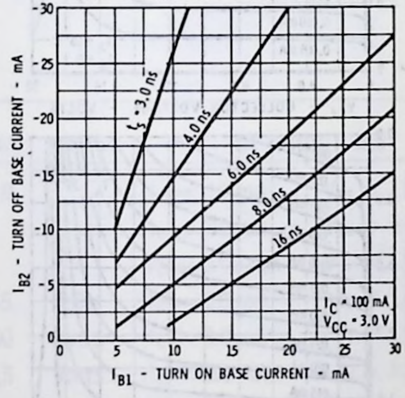
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



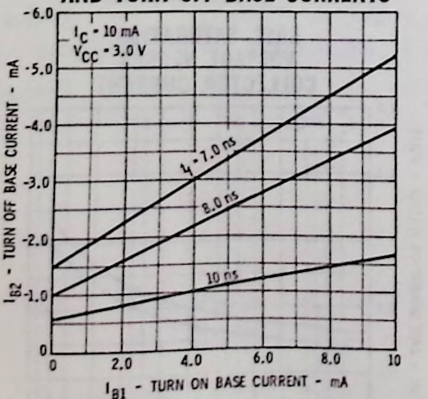
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



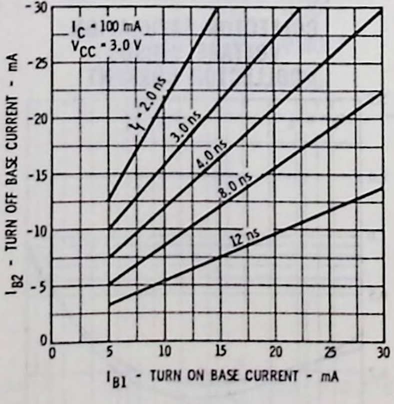
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



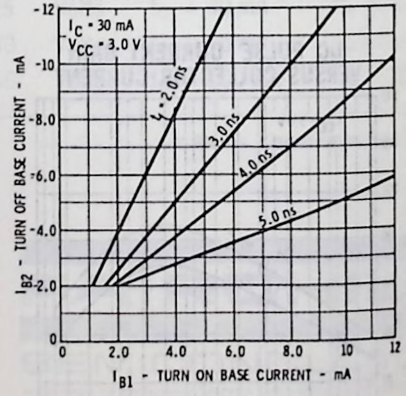
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

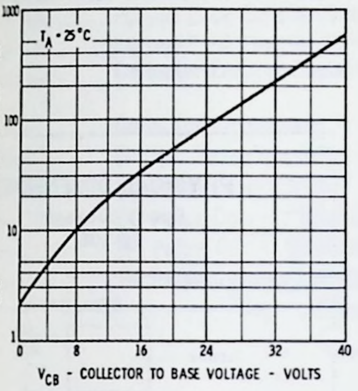


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

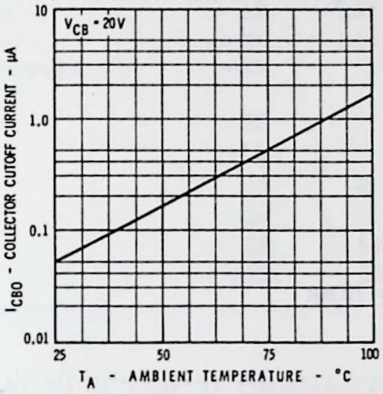


TYPICAL ELECTRICAL CHARACTERISTICS

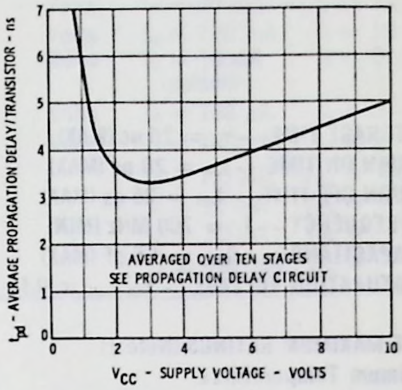
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



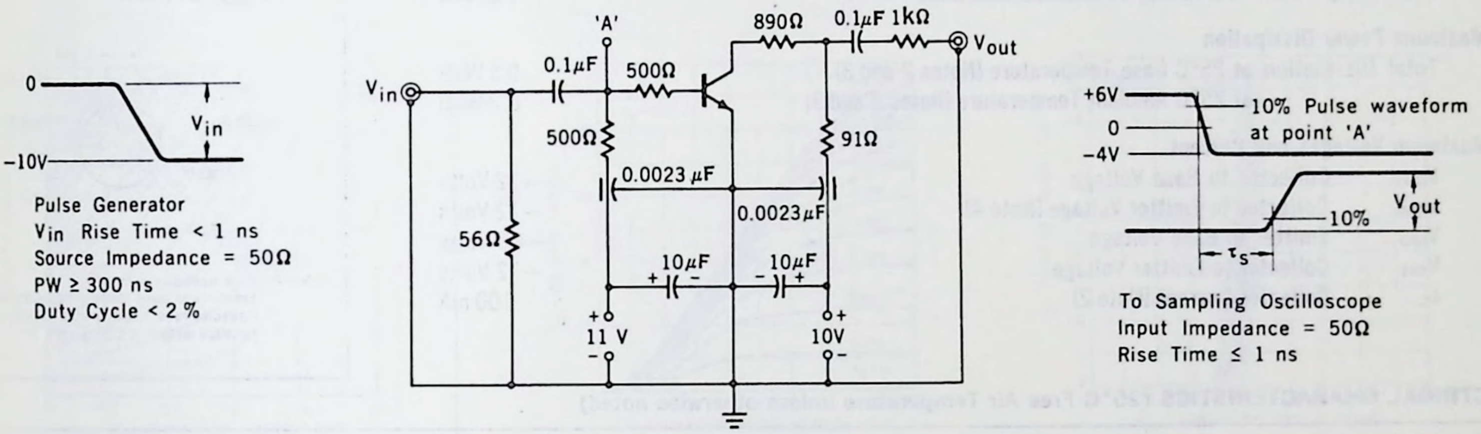
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE



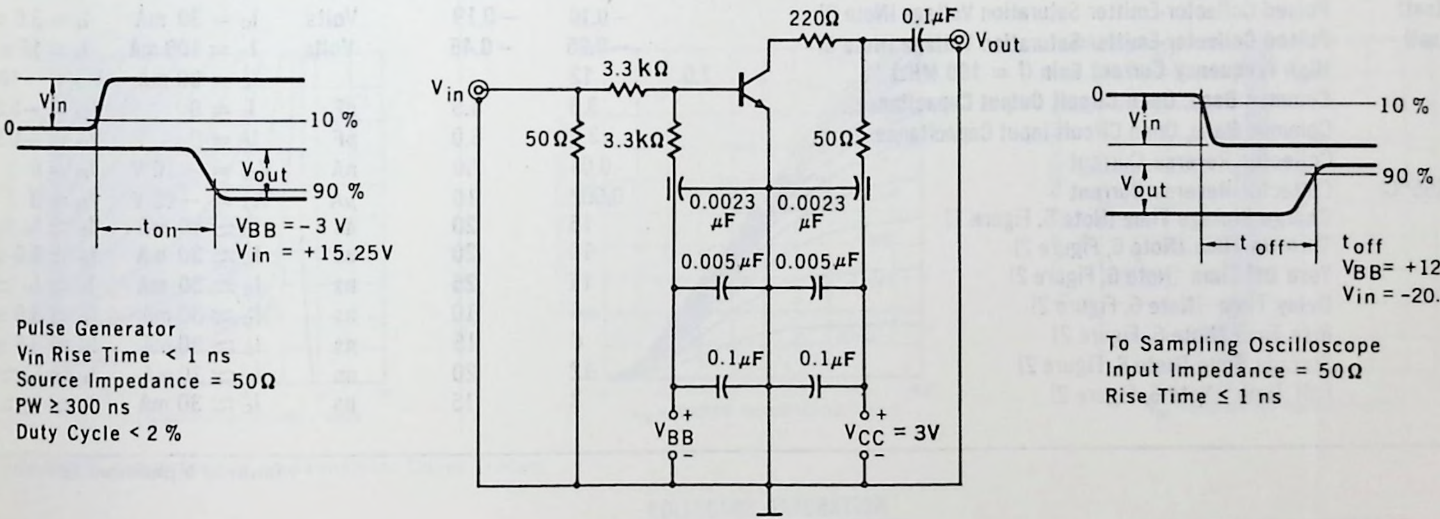
CHARGE STORAGE TIME MEASUREMENT CIRCUIT


0
V_{in}
-10V
V_{in}
0.1μF
'A'
500Ω
890Ω
0.1μF
1kΩ
V_{out}
500Ω
91Ω
0.0023 μF
0.0023μF
56Ω
10μF
10μF
+
11 V
-
+
10V
-
+6V
0
-4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_S

Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT


V_{in}
0
10 %
V_{out}
90 %
t_{on}
V_{in}
3.3 kΩ
220Ω
0.1μF
V_{out}
50Ω
3.3kΩ
50Ω
0.0023 μF
0.0023 μF
0.005μF
0.005μF
0.1μF
0.1μF
+
V_{BB}
-
+
V_{CC} = 3V
-
0
10 %
V_{in}
V_{out}
90 %
t_{off}
t_{off}

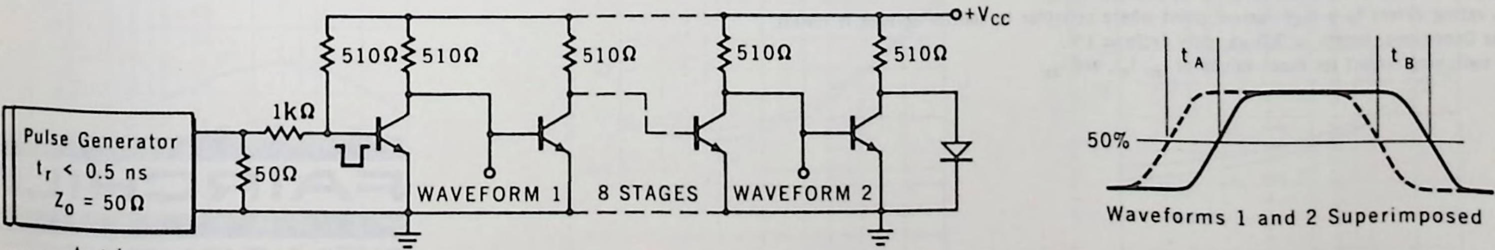
$V_{BB} = -3$ V
$V_{in} = +15.25$V

Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %

$V_{BB} = +12.0$ V
$V_{in} = -20.9$ V

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY


+V_{CC}
510Ω
510Ω
510Ω
510Ω
510Ω
1kΩ
Pulse Generator
t_r < 0.5 ns
Z_o = 50Ω
50Ω
WAVEFORM 1
8 STAGES
WAVEFORM 2
t_A
t_B
50%

Waveforms 1 and 2 Superimposed

$$t_{pd} = \frac{t_A + t_B}{20}$$

t_{pd} = Average Propagation per Transistor

2N4313

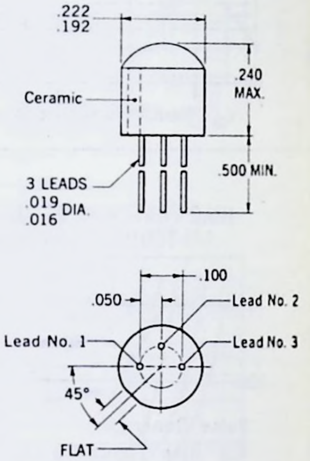
PNP HIGH-SPEED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **LOW STORAGE TIME - - τ_s = 20 ns (MAX)**
- **LOW TURN ON TIME - - t_{on} = 20 ns (MAX)**
- **LOW TURN OFF TIME - - t_{off} = 25 ns (MAX)**
- **HIGH FREQUENCY - - f_T = 700 MHz (MIN)**
- **LOW CAPACITANCE - - C_{obo} = 4.5 pF (MAX)**
- **LOW SATURATION VOLTAGE - - $V_{CE\,(sat)}$ = 0.13 V (MAX) @ I_C = 10 mA**

PHYSICAL DIMENSIONS

Epoxy package
TO-106



NOTES: All dimensions in inches
Emitter and base leads are gold-plated nic
Collector lead is gold-plated KOVAR
Package weight is 0.31 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 seconds time limit)	+260°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	−12 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−12 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts
V_{CES}	Collector to Emitter Voltage	−12 Volts
I_C	Collector Current [Note 2]	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	Typ.	MAX.	UNITS	TEST CONDITIONS	
V_{CE} (sat)	**Pulsed Collector-Emitter Saturation Voltage [Note 5]**		−0.07	−0.13	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE} (sat)	Pulsed Collector-Emitter Saturation Voltage [Note 5]		−0.10	−0.19	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE} (sat)	**Pulsed Collector-Emitter Saturation Voltage [Note 5]**		−0.25	−0.45	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	7.0	12			$I_C = 30$ mA	$V_{CE} = -10$ V
C_{obo}	**Common Base, Open Circuit Output Capacitance**		3.3	4.5	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{ibo}	Common Base, Open Circuit Input Capacitance		3.8	6.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
I_{CES}	Collector Reverse Current		0.05	50	nA	$V_{CE} = -10$ V	$V_{EB} = 0$
I_{CES} (65°C)	Collector Reverse Current		0.002	10	μA	$V_{CE} = -10$ V	$V_{EB} = 0$
τ_s	**Charge Storage Time** [Note 6, Figure 1]		15	20	ns	$I_C \approx 10$ mA	$I_{B1} \approx I_{B2} \approx 10$
t_{on}	**Turn On Time** [Note 6, Figure 2]		10	20	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	**Turn Off Time** [Note 6, Figure 2]		15	25	ns	$I_C \approx 30$ mA	$I_{B1} \approx I_{B2} \approx 3.0$
t_d	Delay Time [Note 6, Figure 2]		4	10	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_r	Rise Time [Note 6, Figure 2]		6	15	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_s	Storage Time [Note 6, Figure 2]		12	20	ns	$I_C \approx 30$ mA	$I_{B1} \approx I_{B2} \approx 3.0$
t_f	Fall Time [Note 6, Figure 2]		3	15	ns	$I_C \approx 30$ mA	$I_{B1} \approx I_{B2} \approx 3.0$

* Planar is a patented Fairchild pro

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient resistance of 500°C/watt (derating factor of 2.0 mW/°C).
(4) This rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

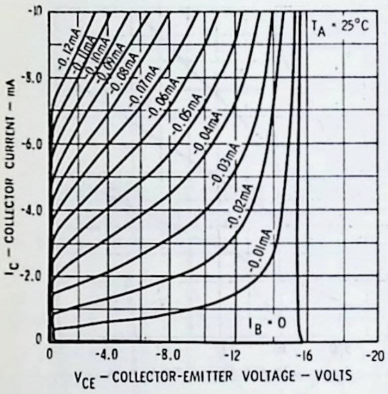
FAIRCHILD TRANSISTOR 2N4313

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

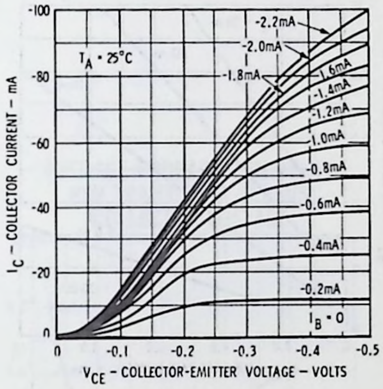
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage		−0.88	−0.92	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage	−0.8	−0.93	−1.15	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage	−0.95	−1.14	−1.5	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{CEO\,(sus)}$	**Collector-Emitter Sustaining Voltage** [Notes 4 and 5]	**−12**			**Volts**	**$I_C = 10$ mA** (pulsed)	**$I_B = 0$**
BV_{CBO}	Collector-Base Breakdown Voltage	−12			Volts	$I_C = 100\ \mu$A	$I_E = 0$
BV_{EBO}	Emitter-Base Breakdown Voltage	−4.5			Volts	$I_E = 100\ \mu$A	$I_C = 0$
h_{FE}	DC Pulse Current Gain	18	44			$I_C = 1.0$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	55			$I_C = 10$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	63	120		$I_C = 30$ mA	$V_{CE} = -0.5$ V
h_{FE}	**DC Pulse Current Gain** [Note 5]	**25**	**55**			**$I_C = 100$ mA**	**$V_{CE} = -1.0$ V**

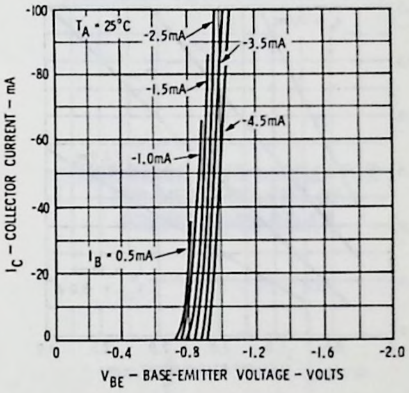
TYPICAL ELECTRICAL CHARACTERISTICS

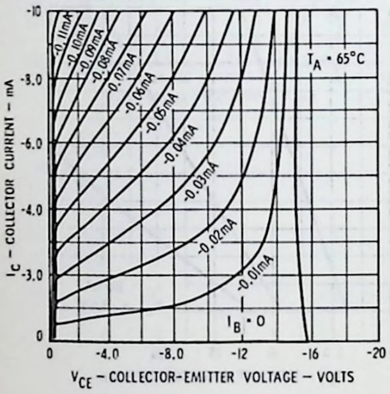
ACTIVE REGION*

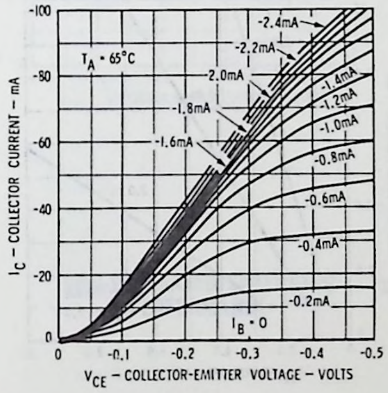


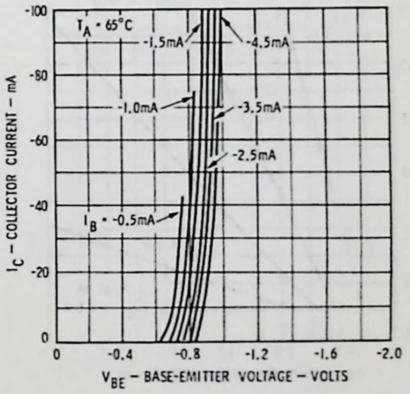
SATURATION REGION*





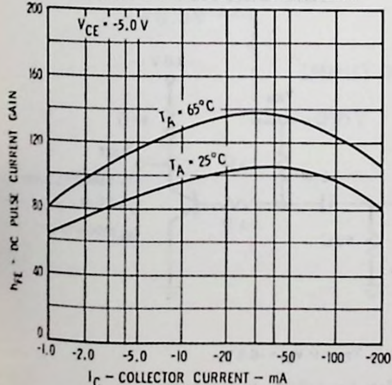




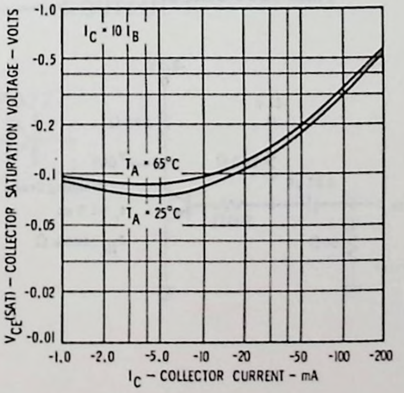


* Single family characteristic on Transistor Curve Tracer.

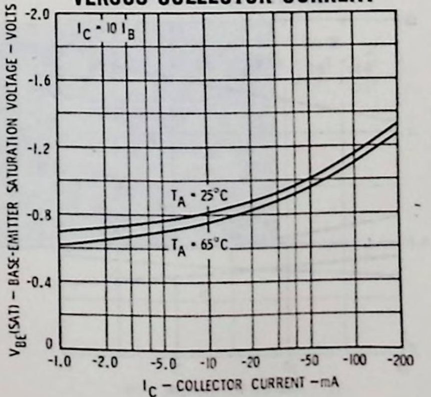
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

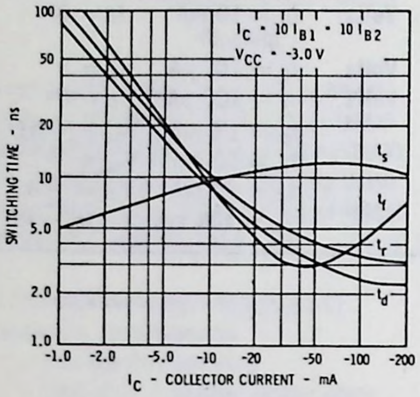


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

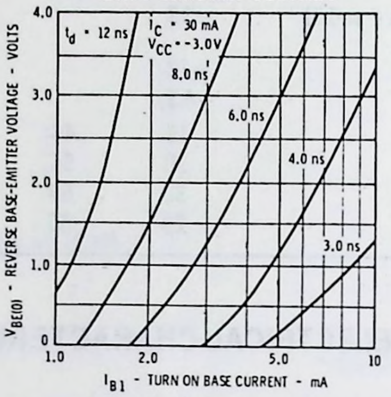


TYPICAL ELECTRICAL CHARACTERISTICS

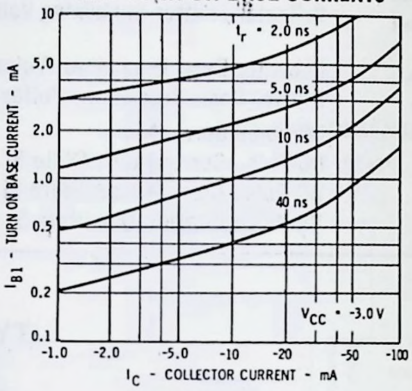
SWITCHING TIME VERSUS COLLECTOR CURRENT



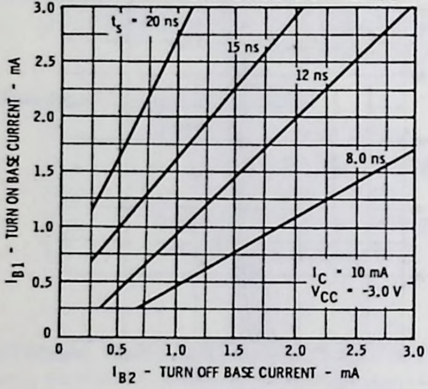
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



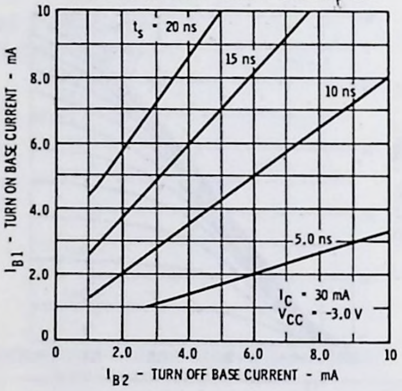
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



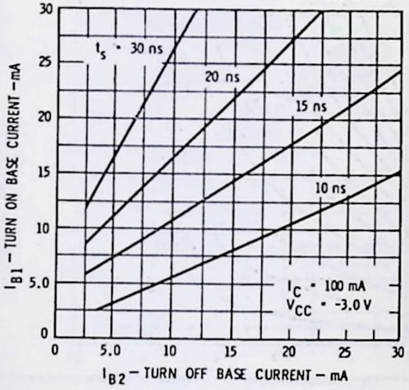
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



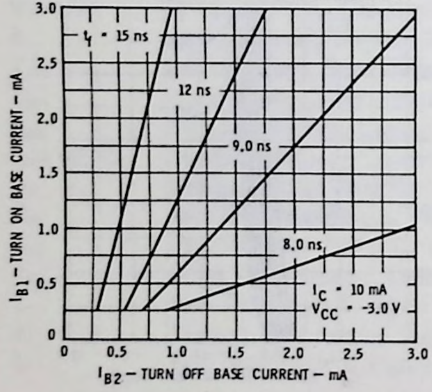
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



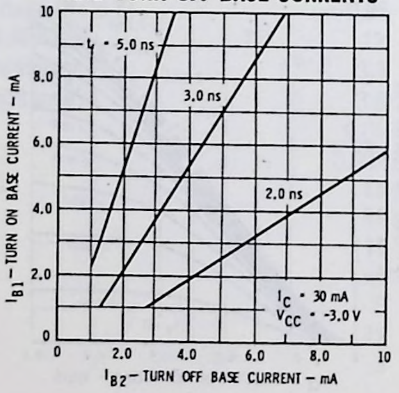
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



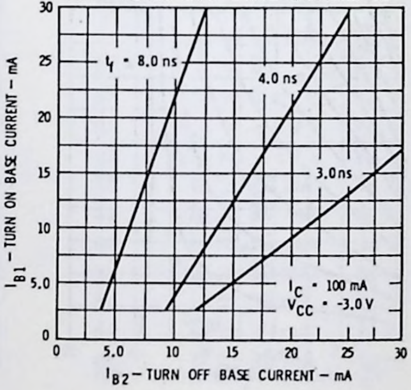
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



SWITCHING TIME VERSUS AMBIENT TEMPERATURE

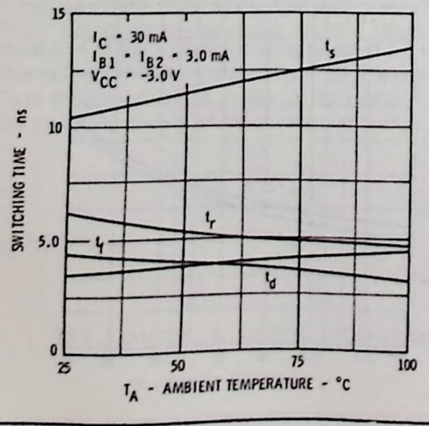
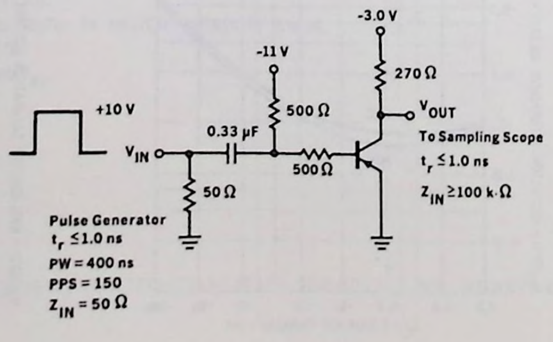
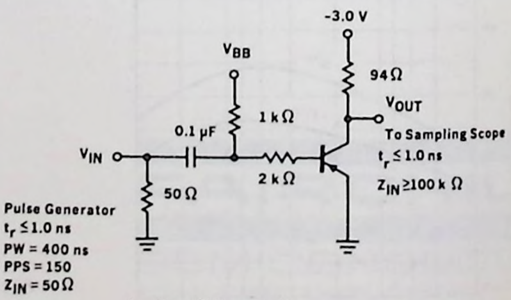


FIG. 1
CHARGE STORAGE TIME TEST CIRCUIT



-3.0 V
-11 V
270 Ω
V_{OUT}
To Sampling Scope
$t_r \leq 1.0$ ns
$Z_{IN} \geq 100$ k Ω
+10 V
0.33 µF
500 Ω
500 Ω
V_{IN}
50 Ω
Pulse Generator
$t_r \leq 1.0$ ns
PW = 400 ns
PPS = 150
$Z_{IN} = 50$ Ω

FIG. 2
SWITCHING TIME TEST CIRCUIT

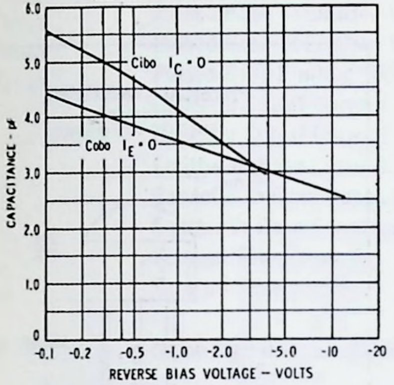


-3.0 V
V_{BB}
94 Ω
V_{OUT}
To Sampling Scope
$t_r \leq 1.0$ ns
$Z_{IN} \geq 100$ k Ω
0.1 µF
1 kΩ
2 kΩ
V_{IN}
50 Ω
Pulse Generator
$t_r \leq 1.0$ ns
PW = 400 ns
PPS = 150
$Z_{IN} = 50$ Ω

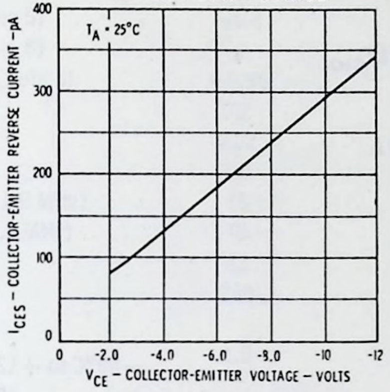
t_{on} $V_{BB} = 0$, $V_{IN} = -6.8$ V

t_{off} $V_{BB} = -9.8$ V , $V_{IN} = +11.65$ V

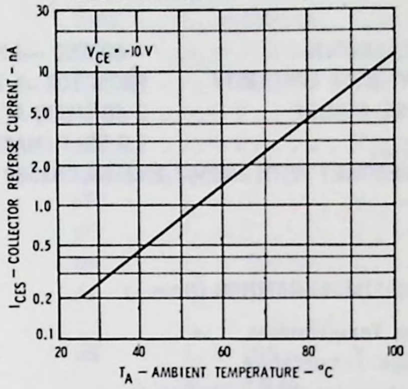
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



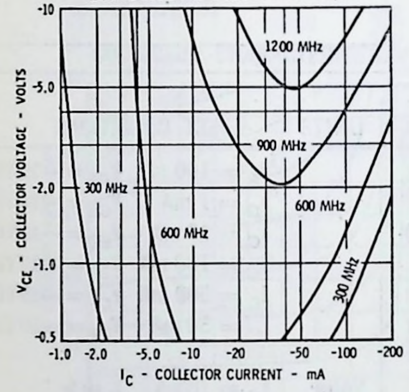
COLLECTOR-EMITTER REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



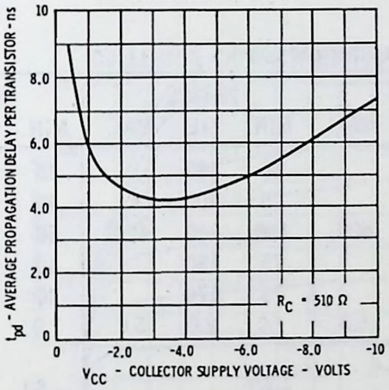
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



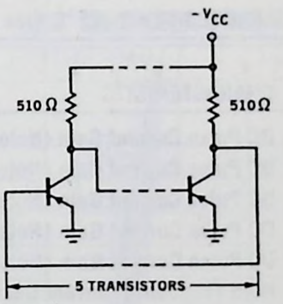
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

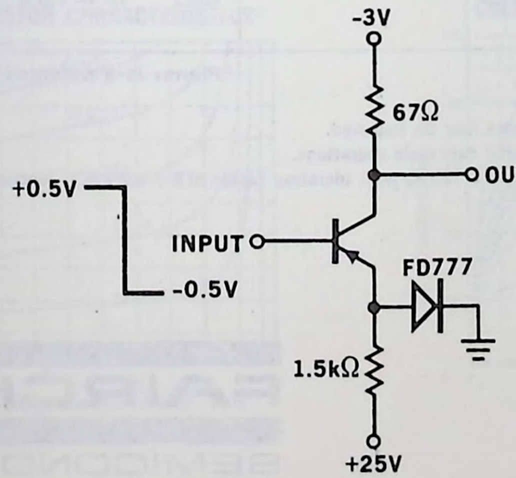


FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

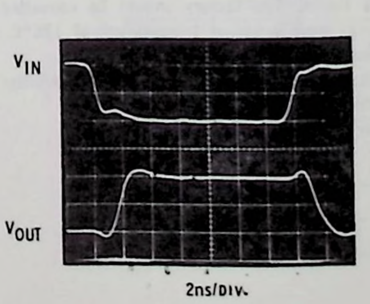

$-V_{CC}$
510 Ω
510 Ω
5 TRANSISTORS

$$t_{pd} = \frac{1}{10\ f_{osc.}}$$

NON-SATURATED SWITCHING PERFORMANCE


-3V
67Ω
OUTPUT
+0.5V
-0.5V
INPUT
FD777
1.5kΩ
+25V

$t_{on} = 2$ ns Typ.
$t_{off} = 2$ ns Typ.



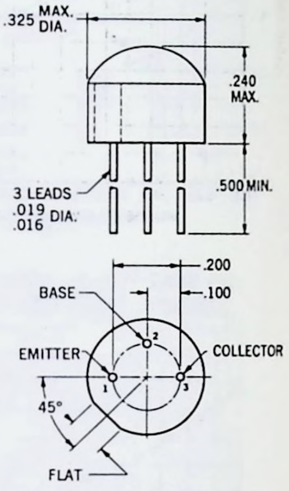
2N4354 • 2N4355 • 2N4356

PNP LOW LEVEL, LOW NOISE AMPLIFIERS AND HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH BREAKDOWN . . . . —60 AND —80 VOLT (MIN) LV$_{CEO}$**
- **EXCELLENT BETA LINEARITY . . . FROM 100 μA TO 500 mA**
- **LOW NOISE FIGURE . . . . 3 dB (MAX) AT 1.0 kHz**
- **LOW V$_{CE(sat)}$ . . . . 1.0 VOLT (MAX) AT I$_C$ = 1.0 A**
- **COMPLEMENTARY WITH 2N3567, 2N3568, 2N3569**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	125°C
Lead Temperature (Soldering, 10 second time limit)	260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	**0.8 Watt**
at 25°C Ambient Temperature	0.35 Watt

Maximum Voltages

		2N4354 2N4355	2N4356
V_{CBO}	Collector to Base Voltage	−60 Volts	−80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−60 Volts	−80 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N4354			2N4355			2N4356				
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	**DC Pulse Current Gain** (Note 5)	25	110		**60**	**180**		**25**	**160**			**$I_C = 100\ \mu A$ $V_{CE} = -10\ V$**
h_{FE}	DC Pulse Current Gain (Note 5)	40	120		75	200		40	180			$I_C = 1\ mA$ $V_{CE} = -10\ V$
h_{FE}	**DC Pulse Current Gain** (Note 5)	50	120	500	**100**	**200**	**400**	**50**	**180**	**250**		**$I_C = 10\ mA$ $V_{CE} = -10\ V$**
h_{FE}	DC Pulse Current Gain (Note 5)	40	115		75	190		40	170			$I_C = 100\ mA$ $V_{CE} = -10\ V$
h_{FE}	**DC Pulse Current Gain** (Note 5)	30	110		**75**	**170**		**30**	**160**			**$I_C = 500\ mA$ $V_{CE} = -10\ V$**
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.0	2.0	5.0	1.0	2.0	5.0	1.0	2.0	5.0		$I_C = 50\ mA$ $V_{CE} = -10\ V$
BV_{CBO}	Collector to Base Breakdown Voltage	−60			−60			−80			Volts	$I_C = 10\ \mu A$ $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			−5.0			Volts	$I_C = 0$ $I_E = 10\ \mu A$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	−60			**−60**			**−80**			**Volts**	**$I_C = 10\ mA$ $I_B = 0$ (pulsed)**
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)					**−0.5**	**−1.0**				**Volts**	**$I_C = 1.0\ A$ $I_B = 100\ mA$**
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)						**−1.2**				**Volts**	**$I_C = 1.0\ A$ $I_B = 100\ mA$**
$V_{BE(ON)}$	Pulsed Base Emitter "ON" Voltage (Note 5)					−1.05	−1.20				Volts	$I_C = 1.0\ A$ $V_{CE} = -1.0\ V$

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient therma resistance of 286°C/Watt (derating factor of 3.5 mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I$_C$, I$_{B1}$, and I$_{B2}$.

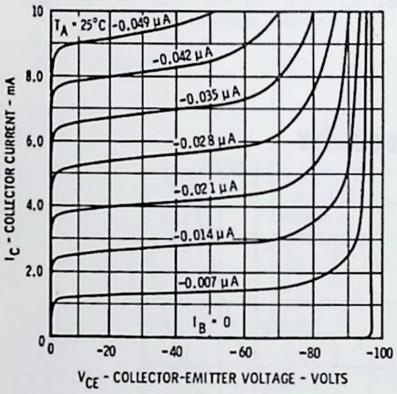
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

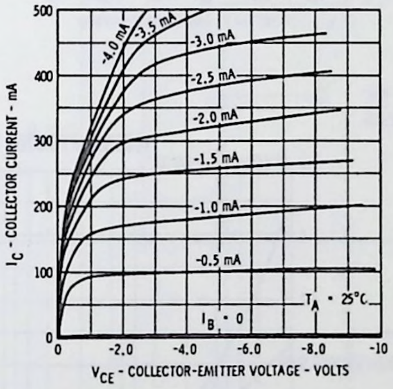
SYMBOL	CHARACTERISTIC	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)	−0.10	−0.15	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)	**−0.25**	**−0.5**	**Volts**	**$I_C = 500$ mA**	**$I_B = 50$ mA**
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)	−0.8	−0.9	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−1.1	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{BE(ON)}$	Pulsed Base Emitter "ON" Voltage (Note 5)	−0.95	−1.1	Volts	$I_C = 500$ mA	$V_{CE} = -0.5$ V
I_{CBO}	Collector Cutoff Current	0.2	50	nA	$I_E = 0$	$V_{CB} = -50$ V
$I_{CBO}(+75°C)$	Collector Cutoff Current	0.02	5.0	μA	$I_E = 0$	$V_{CB} = -50$ V
I_{EBO}	Emitter to Base Current	1.0	100	nA	$I_C = 0$	$V_{EB} = -4.0$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)	15	30	pF	$I_C = 0$	$V_{CB} = -10$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)	75	110	pF	$I_C = 0$	$V_{EB} = -0.5$ V
t_{on}	Turn-on Time (Note 6)	23	100	ns	$I_C \simeq 500$ mA	$I_{B1} \simeq 50$ mA
t_{off}	Turn-off Time (Note 6)	200	400	ns	$I_C \simeq 500$ mA $I_{B2} \simeq -50$ mA	$I_{B1} \simeq 50$ mA
NF	**Noise Figure (f = 1.0 kHz)**	**1.0**	**3.0**	**dB**	**$I_C = 100$ μA** **$R_S = 1.0$ kΩ**	**$V_{CE} = -10$ V**

TYPICAL ELECTRICAL CHARACTERISTICS

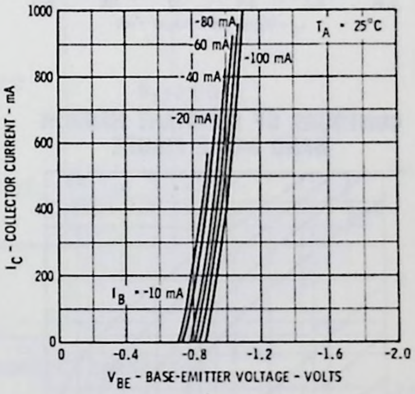
COLLECTOR CHARACTERISTICS°



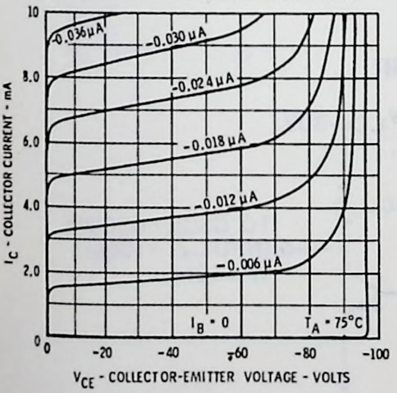
COLLECTOR CHARACTERISTICS°



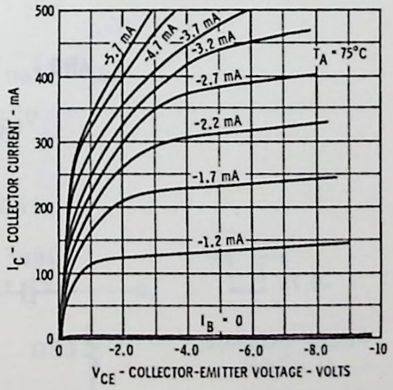
BASE CHARACTERISTICS°



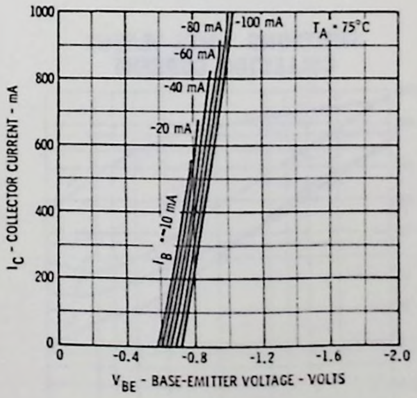
COLLECTOR CHARACTERISTICS°



COLLECTOR CHARACTERISTICS°

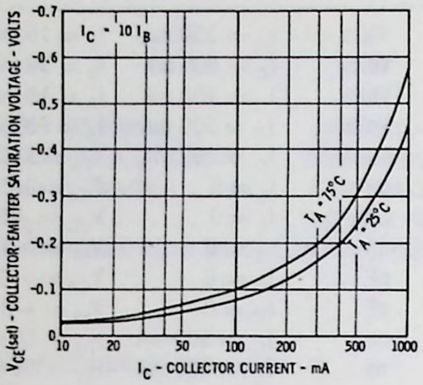


BASE CHARACTERISTICS°

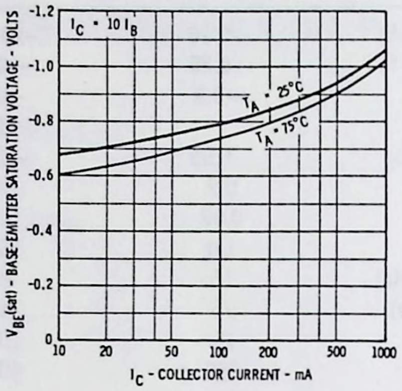


°Single family characteristic on Transistor Curve Tracer.

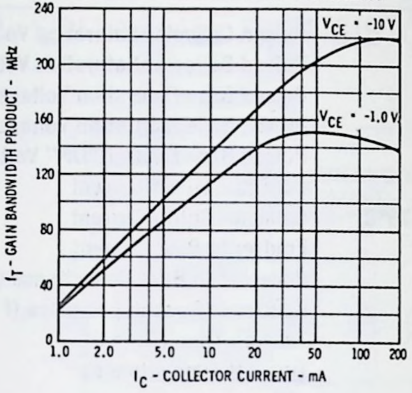
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



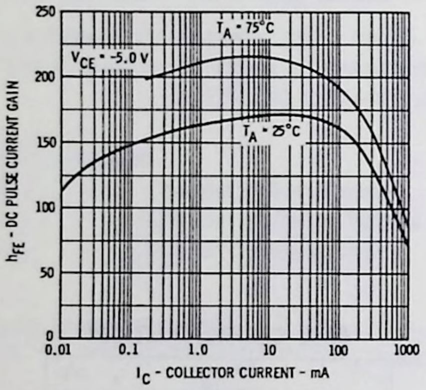
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



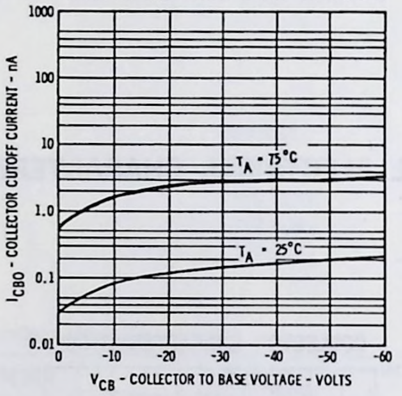
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



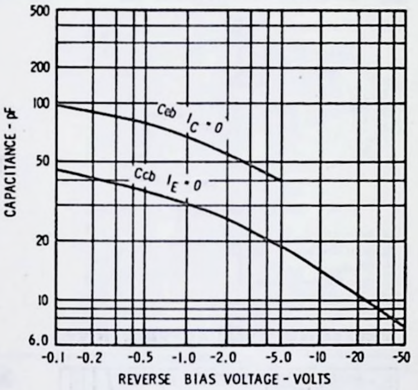
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



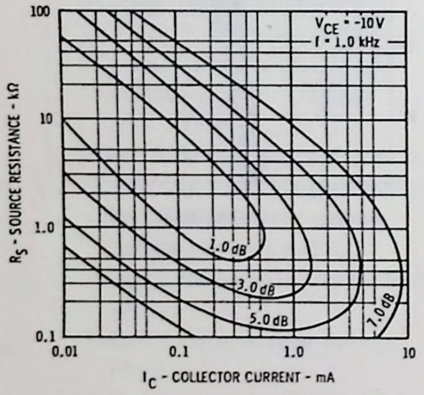
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



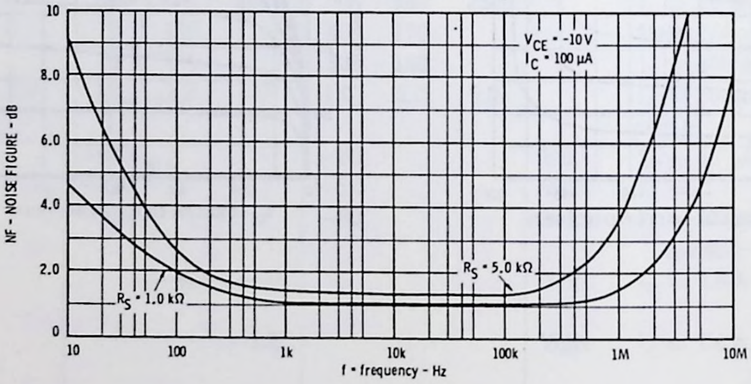
COMMON BASE OPEN CIRCUIT INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



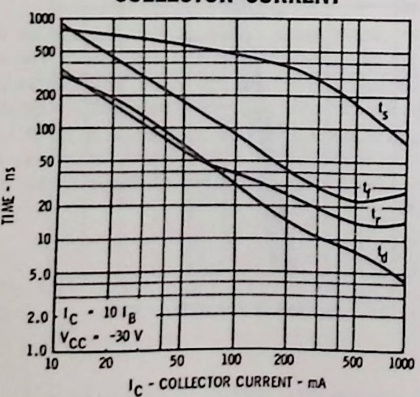
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



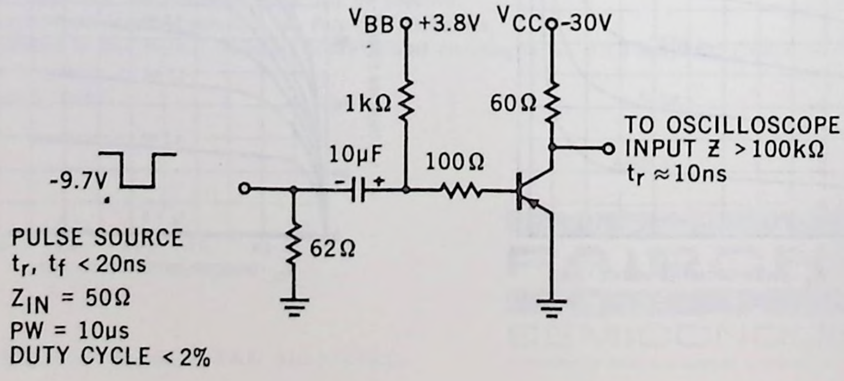
NOISE FIGURE VERSUS FREQUENCY



SWITCHING TIMES VERSUS COLLECTOR CURRENT



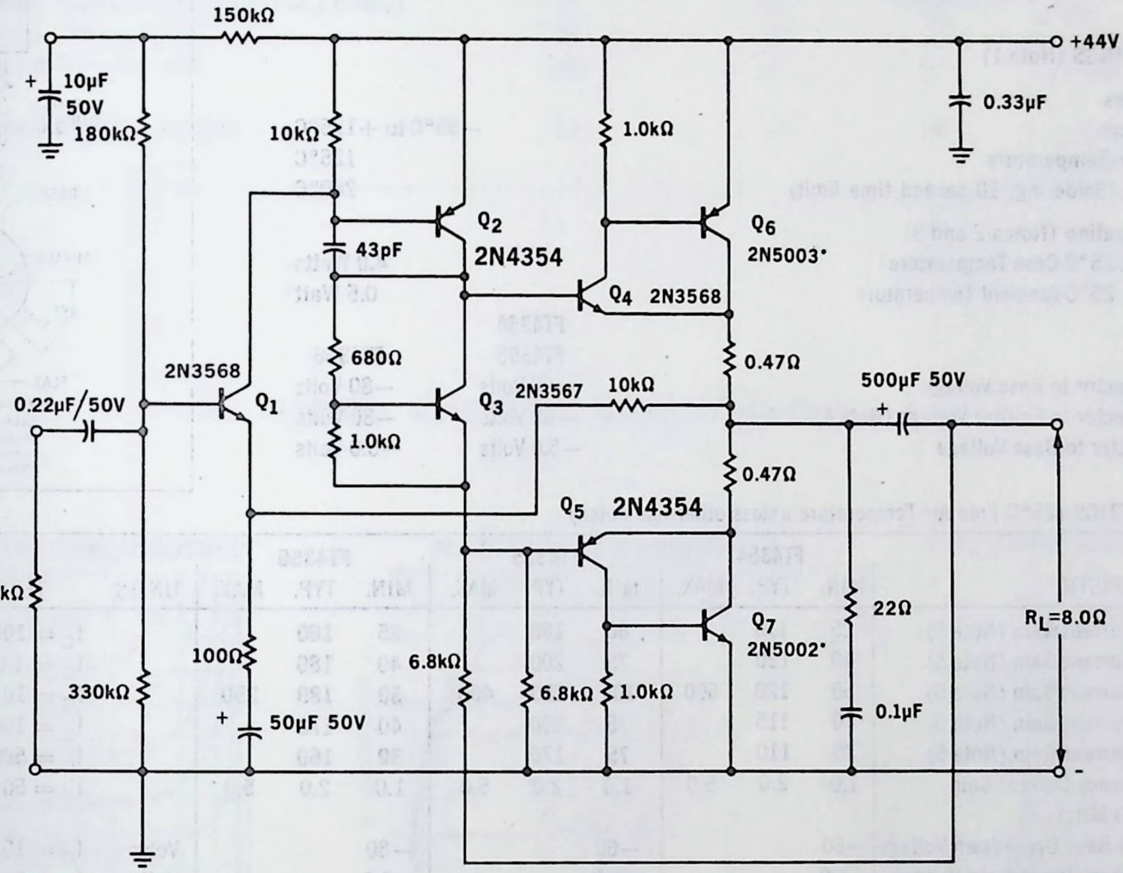
t_{on} AND t_{off} TEST CIRCUIT


V_{BB} +3.8V
V_{CC} -30V
1kΩ
60Ω
10µF
100Ω
62Ω
-9.7V
TO OSCILLOSCOPE
INPUT Z > 100kΩ
$t_r \approx 10ns$
PULSE SOURCE
t_r, t_f < 20ns
Z_{IN} = 50Ω
PW = 10µs
DUTY CYCLE < 2%

TYPICAL SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	800	Ω	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{oe}	Output Conductance	75	μmho	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{re}	Voltage Feedback Ratio	180	$X10^{-6}$	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{fe}	Small Signal Current Gain	140		$I_C = 10$ mA	$V_{CE} = -10$ V

TYPICAL 25 WATT POWER AMPLIFIER
USING THE 2N4354 IN THE DRIVER STAGES


150kΩ
+44V
+
10μF
50V
180kΩ
0.33μF
10kΩ
1.0kΩ
43pF
Q2
2N4354
Q6
2N5003*
Q4
2N3568
680Ω
0.47Ω
2N3568
Q1
2N3567
Q3
10kΩ
500μF 50V
+
0.22μF/50V
1.0kΩ
0.47Ω
Q5
2N4354
100kΩ
Q7
2N5002*
22Ω
RL=8.0Ω
100Ω
6.8kΩ
6.8kΩ
1.0kΩ
330kΩ
+
50μF 50V
0.1μF
-

*FOR EQUIVALENT SILICON OUTPUT TRANSISTOR

FT4354 • FT4355 • FT4356

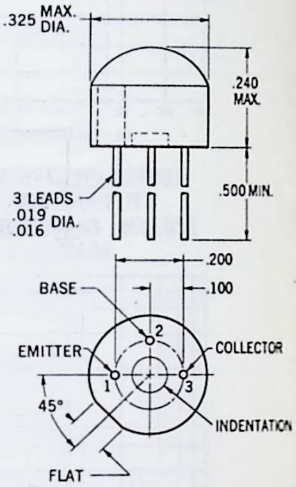
PNP LOW LEVEL, LOW NOISE AMPLIFIERS AND HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SIMILAR TO 2N4354 • 2N4355 • 2N4356 EXCEPT FOR INCREASED POWER DISSIPATIO

- **HIGH POWER DISSIPATION . . . 4.0 WATTS AT 25°C CASE TEMPERATURE**
- **HIGH BREAKDOWN . . . . —60 AND —80 VOLT (MIN) LV_{CEO}**
- **EXCELLENT BETA LINEARITY . . . FROM 100 μA TO 500 mA**
- **LOW NOISE FIGURE . . . . 3 dB (MAX) AT 1.0 kHz**
- **LOW $V_{CE(sat)}$ . . . . 1.0 VOLT (MAX) AT $I_C = 1.0$ A**
- **COMPLEMENTARY WITH FT3567, FT3568, FT3569**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature	−55°C to +125°C	
Operating Junction Temperature	125°C	
Lead Temperature (Soldering, 10 second time limit)	260°C	
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature	**4.0 Watts**	
at 25°C Ambient Temperature	0.5 Watt	
Maximum Voltages	**FT4354 FT4355**	**FT4356**
V_{CBO} Collector to Base Voltage	−60 Volts	−80 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	−60 Volts	−80 Volts
V_{EBO} Emitter to Base Voltage	−5.0 Volts	−5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FT4354 MIN.	FT4354 TYP.	FT4354 MAX.	FT4355 MIN.	FT4355 TYP.	FT4355 MAX.	FT4356 MIN.	FT4356 TYP.	FT4356 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	25	110		**60**	**180**		**25**	**160**			$I_C = 100$ μA	$V_{CE} = -10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	40	120		75	200		40	180			$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	50	120	500	**100**	**200**	**400**	**50**	**180**	**250**		$I_C = 10$ mA	$V_{CE} = -10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	40	115		75	190		40	170			$I_C = 100$ mA	$V_{CE} = -10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	30	110		**75**	**170**		**30**	**160**			$I_C = 500$ mA	$V_{CE} = -10$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.0	2.0	5.0	1.0	2.0	5.0	1.0	2.0	5.0		$I_C = 50$ mA	$V_{CE} = -10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	−60			−60			−80			Volts	$I_C = 10$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			−5.0			Volts	$I_C = 0$	$I_E = 10$ μA
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	−60			**−60**			**−80**			**Volts**	**$I_C = 10$ mA (pulsed)**	**$I_B = 0$**
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)					**−0.5**	**−1.0**				**Volts**	**$I_C = 1.0$ A**	**$I_B = 100$ mA**
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)						**−1.2**				**Volts**	**$I_C = 1.0$ A**	**$I_B = 100$ mA**
$V_{BE(ON)}$	Pulsed Base Emitter "ON" Voltage (Note 5)					−1.05	−1.20				Volts	$I_C = 1.0$ A	$V_{CE} = -1.0$ V

*Planar is a patented Fairchild proces

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C); junction to ambient ther resistance of 200°C/Watt (derating factor of 5.0 mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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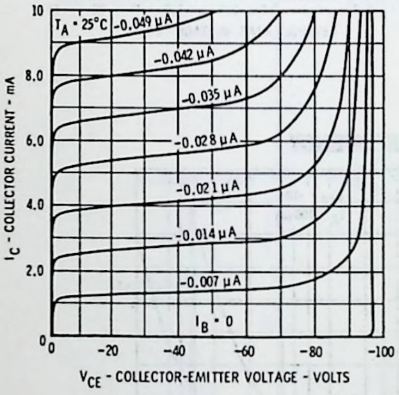
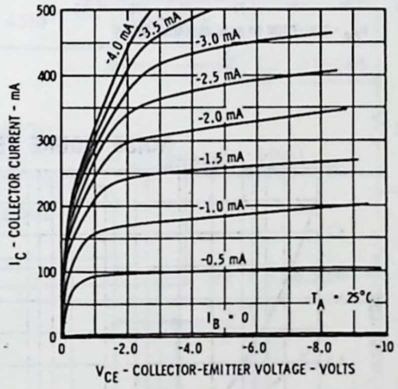
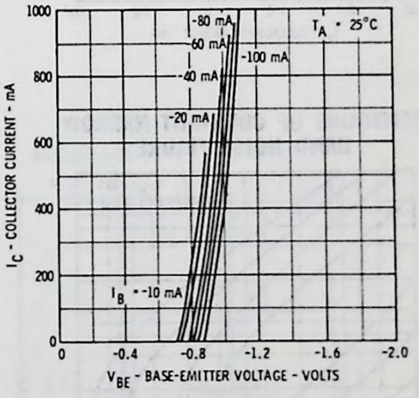
LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

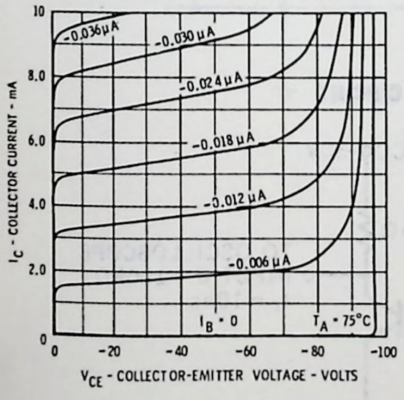
SYMBOL	CHARACTERISTIC	TYP.	MAX.	UNITS	TEST CONDITIONS
$V'_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)	−0.10	−0.15	Volts	$I_C = 150$ mA $I_B = 15$ mA
$V'_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)	**−0.25**	**−0.5**	**Volts**	**$I_C = 500$ mA $I_B = 50$ mA**
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)	−0.8	−0.9	Volts	$I_C = 150$ mA $I_B = 15$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−1.1	Volts	$I_C = 500$ mA $I_B = 50$ mA
$V_{BE(ON)}$	Pulsed Base Emitter "ON" Voltage (Note 5)	−0.95	−1.1	Volts	$I_C = 500$ mA $V_{CE} = -0.5$ V
I_{CBO}	Collector Cutoff Current	0.2	50	nA	$I_E = 0$ $V_{CB} = -50$ V
I_{CBO}(+75°C)	Collector Cutoff Current	0.02	5.0	μA	$I_E = 0$ $V_{CB} = -50$ V
I_{EBO}	Emitter to Base Current	1.0	100	nA	$I_C = 0$ $V_{EB} = -4.0$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)	15	30	pF	$I_C = 0$ $V_{CB} = -10$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)	75	110	pF	$I_C = 0$ $V_{EB} = -0.5$ V
t_{on}	Turn-on Time (Note 6)	23	100	ns	$I_C \simeq 500$ mA $I_{B1} \simeq 50$ mA
t_{off}	Turn-off Time (Note 6)	200	400	ns	$I_C \simeq 500$ mA $I_{B1} \simeq 50$ mA $I_{B2} \simeq -50$ mA
NF	**Noise Figure (f = 1.0 kHz)**	**1.0**	**3.0**	**dB**	**$I_C = 100$ μA $V_{CE} = -10$ V** **$R_S = 1.0$ kΩ**

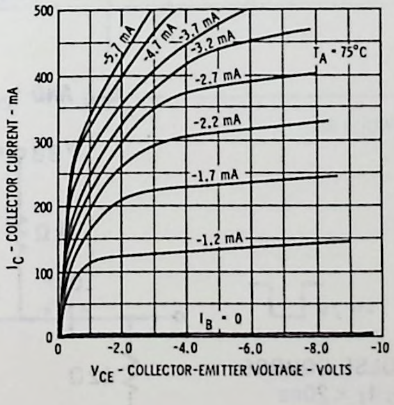
TYPICAL ELECTRICAL CHARACTERISTICS

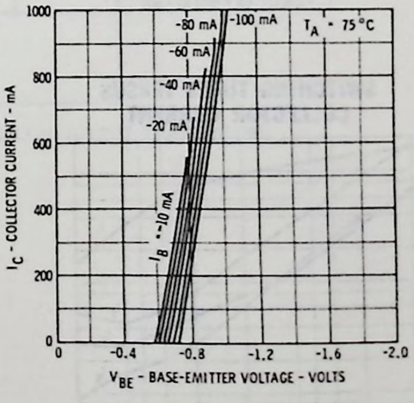

COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*


BASE CHARACTERISTICS*

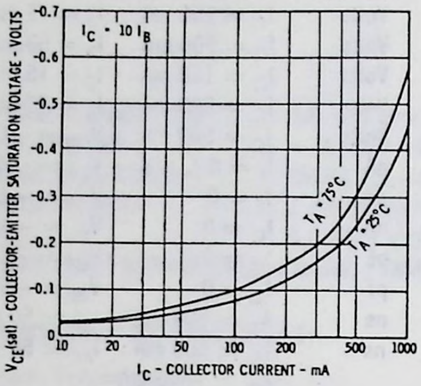

COLLECTOR CHARACTERISTICS*


COLLECTOR CHARACTERISTICS*

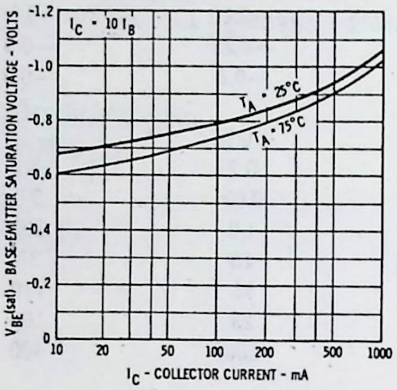

BASE CHARACTERISTICS*

*Single family characteristic on Transistor Curve Tracer.

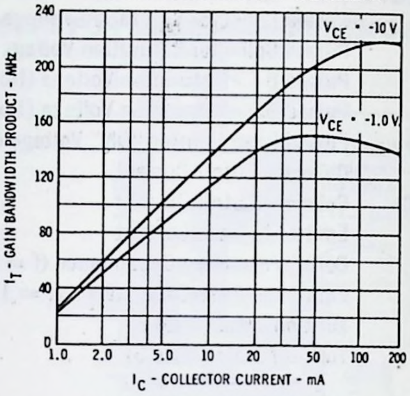
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



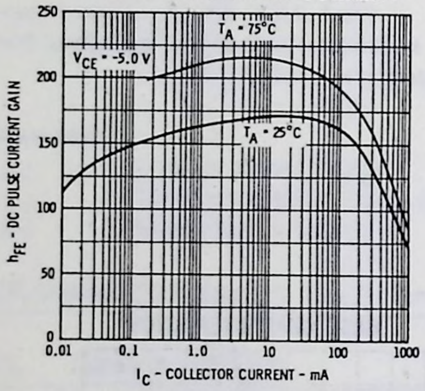
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



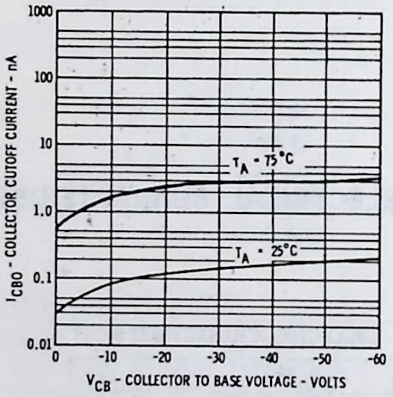
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



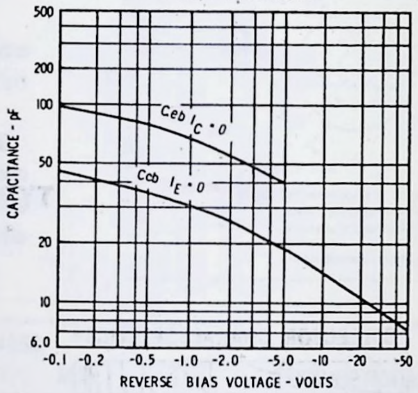
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



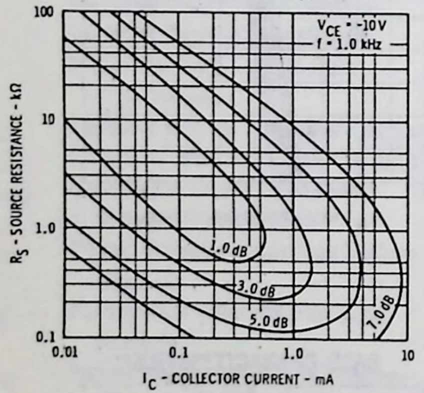
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



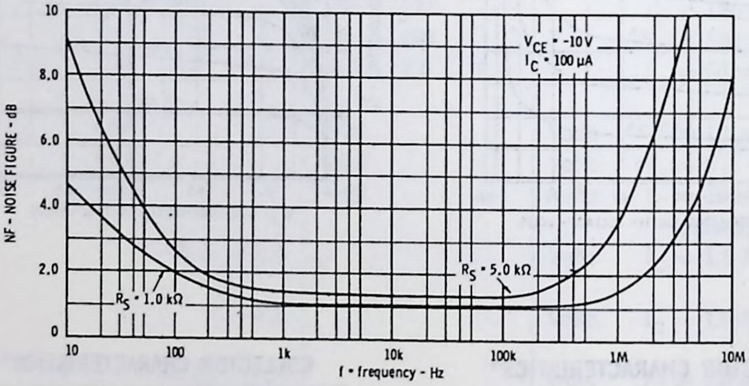
COMMON BASE OPEN CIRCUIT INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



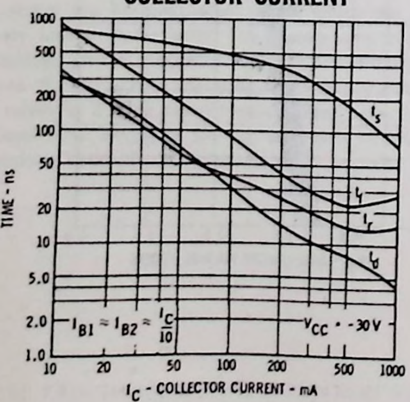
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



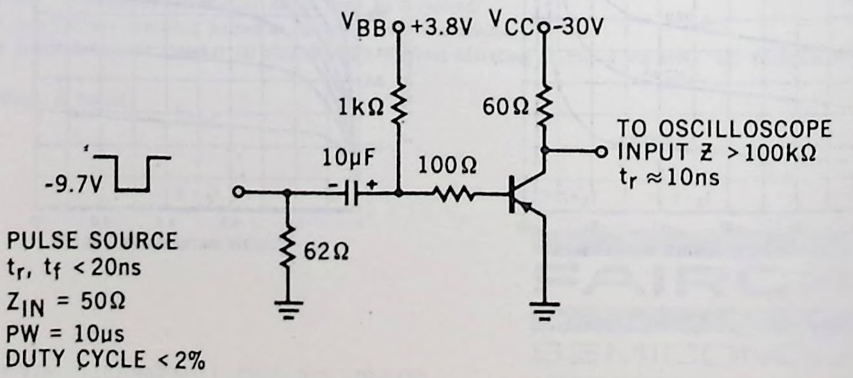
NOISE FIGURE VERSUS FREQUENCY



SWITCHING TIMES VERSUS COLLECTOR CURRENT



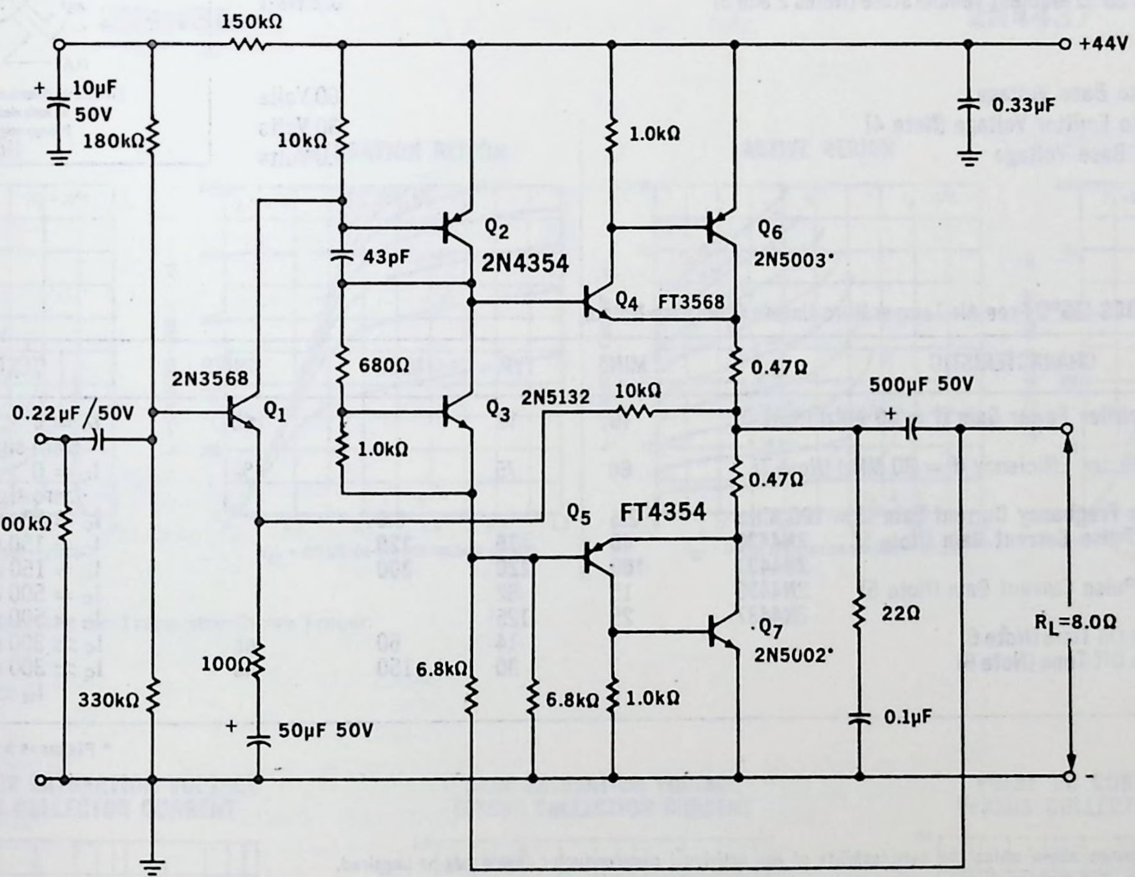
t_{ON} AND t_{OFF} TEST CIRCUIT


V_{BB} +3.8V
V_{CC} -30V
1kΩ
60Ω
TO OSCILLOSCOPE
INPUT Z >100kΩ
$t_r \approx 10ns$
10µF
100Ω
-9.7V
62Ω
PULSE SOURCE
t_r, t_f < 20ns
Z_{IN} = 50Ω
PW = 10µs
DUTY CYCLE < 2%

TYPPICAL SMALL SIGNAL CHARACTERISTICS ($f = 1$ kHz)

SYMBOL	CHARACTERISTICS	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	800	Ω	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{oe}	Output Conductance	75	μmho	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{re}	Voltage Feedback Ratio	180	X10⁻⁶	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{fe}	Small Signal Current Gain	140		$I_C = 10$ mA	$V_{CE} = -10$ V

TYPICAL 25 WATT POWER AMPLIFIER
USING THE FT4354 IN THE DRIVER STAGES


150kΩ
+44V
+
10μF
50V
180kΩ
10kΩ
1.0kΩ
0.33μF
Q2
2N4354
43pF
Q6
2N5003*
Q4
FT3568
680Ω
0.47Ω
2N3568
Q1
Q3
2N5132
10kΩ
500μF 50V
+
0.22μF/50V
1.0kΩ
0.47Ω
100kΩ
Q5
FT4354
22Ω
Q7
2N5002*
RL=8.0Ω
100Ω
6.8kΩ
6.8kΩ
1.0kΩ
330kΩ
+
50μF 50V
0.1μF

*OR EQUIVALENT SILICON OUTPUT TRANSISTOR

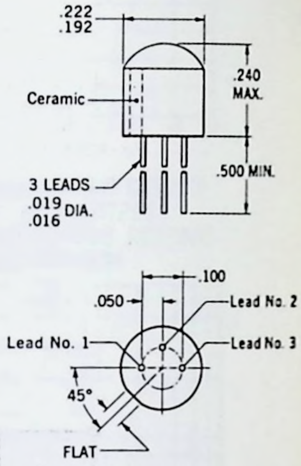
2N4436 • 2N4437

NPN CLASS-C RF AMPLIFIERS AND HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH GAIN -- 400 mW RF POWER OUT @ 30 MHz**
- **HIGH BETA -- 100 MIN @ 150 mA, 25 MIN @ 500 mA**
- **HIGH f_T -- 250 MHz MIN @ 50 mA**
- **FAST SWITCHING -- 60 ns MAX t_{on} AND 150 ns MAX t_{off} @ 300 mA**
- **LOW $V_{CE(sat)}$ -- 0.22 V MAX @ 150 mA, 0.35 V TYP. @ 500 mA**

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	125°C
Lead Temperature (Soldering, 10 second time limit)	260°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

SYMBOL	CHARACTERISTIC		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
G_{PE}	**Amplifier Power Gain (f = 30 MHz)** [Note 7]		**10**	**12**		**dB**	**$I_C = 0$ $V_{CE} = 15$ V** (zero signal)
η	Collector Efficiency (f = 30 MHz) [Note 7]		60	75		%	$I_C = 0$ $V_{CE} = 15$ V (zero signal)
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**		**2.5**		**8.0**		**$I_C = 50$ mA $V_{CE} = 5.0$ V**
h_{FE}	**DC Pulse Current Gain** [Note 5]	**2N4436**	**40**	**75**	**120**		$I_C = 150$ mA $V_{CE} = 10$ V
		2N4437	**100**	**220**	**300**		$I_C = 150$ mA $V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain [Note 5]	2N4436	15	62			$I_C = 500$ mA $V_{CE} = 10$ V
		2N4437	25	125			$I_C = 500$ mA $V_{CE} = 10$ V
t_{on}	Turn On Time [Note 6]			14	60	ns	$I_C \approx 300$ mA $I_{B1} \approx 30$ mA
t_{off}	Turn Off Time [Note 6]			80	150	ns	$I_C \approx 300$ mA $I_{B1} \approx 30$ mA $I_{B2} \approx 30$ mA

* Planar is a patented Fairchild

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient thermal ance of 500°C/watt (derating factor of 2.0 mW/°C).

(4) This rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300μs; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

(7) $P_{IN} = 40$ mW. See Test Circuit.

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS 2N4436 • 2N4437

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

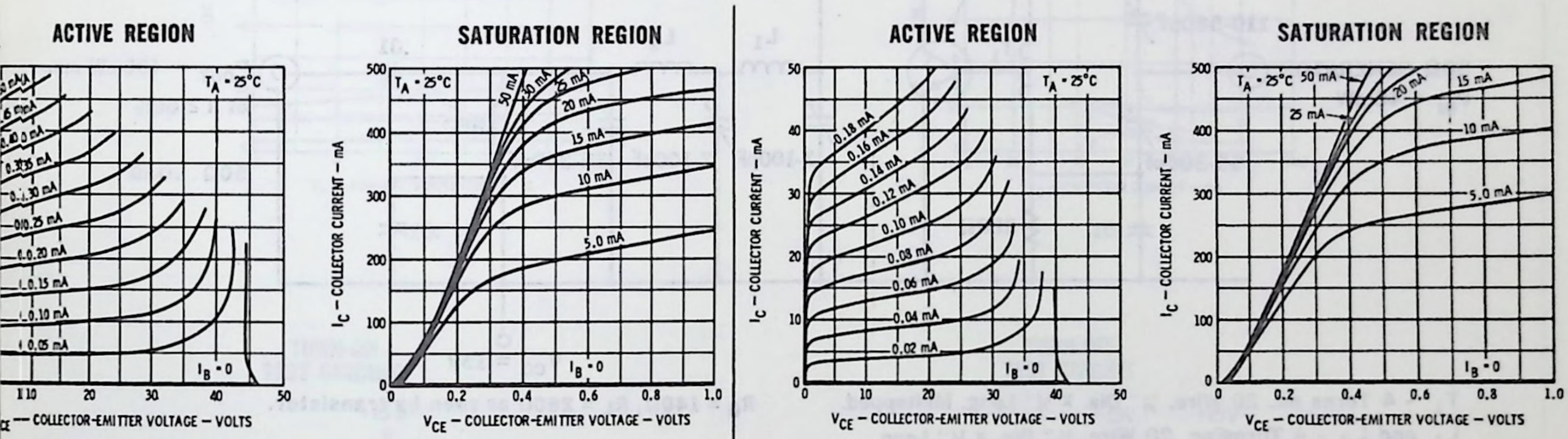
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CBO}	Collector to Base Breakdown Voltage	60			Volts	$I_C = 10\ \mu A$	$I_E = 0$
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	30			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
C_{obo}	Output Capacitance (f = 1.0 MHz)			8.0	pF	$I_E = 0$	$V_{CB} = 10$ V
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage [Note 5]**		**0.13**	**0.22**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
$V_{BE(sat)}$	Pulsed Emitter Saturation Voltage [Note 5]			1.10	Volts	$I_C = 150$ mA	$I_B = 15$ mA
I_{CES}	Collector Reverse Current			0.05	μA	$V_{CE} = 50$ V	$V_{EB} = 0$
I_{CES} (65°C)	Collector Reverse Current			1.0	μA	$V_{CE} = 50$ V	$V_{EB} = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

COLLECTOR CHARACTERISTICS*

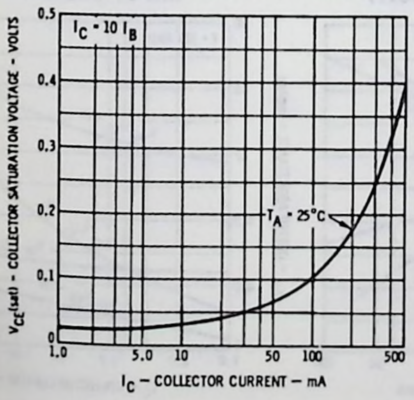
2N4436

2N4437

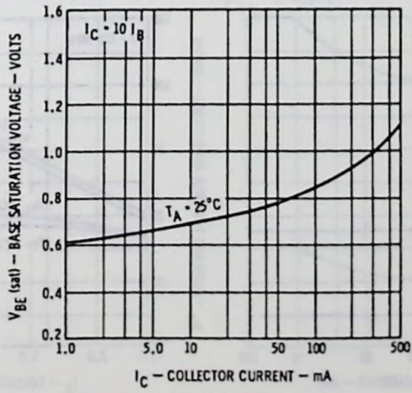


ingle family characteristic on Transistor Curve Tracer.

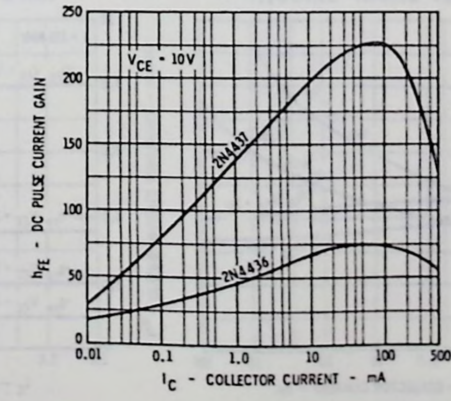
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTION CURRENT

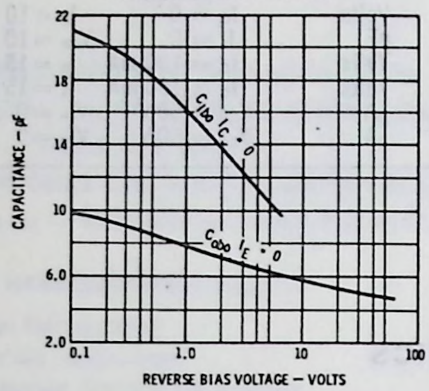


PULSE DC CURRENT GAIN VERSUS COLLECTOR CURRENT

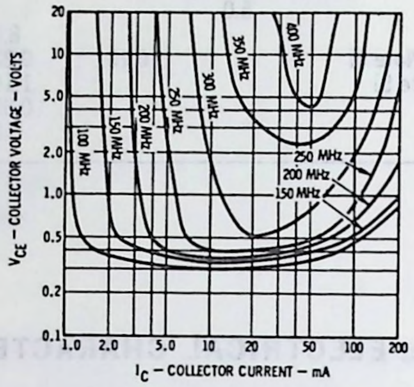


TYPICAL ELECTRICAL CHARACTERISTICS

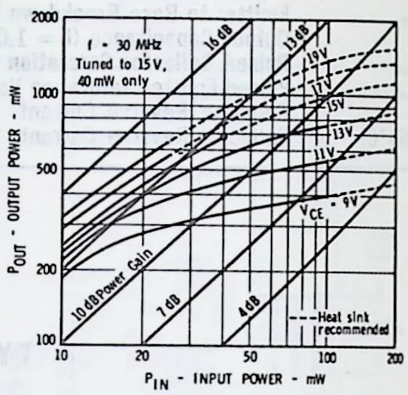
EMITTER TRANSITION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



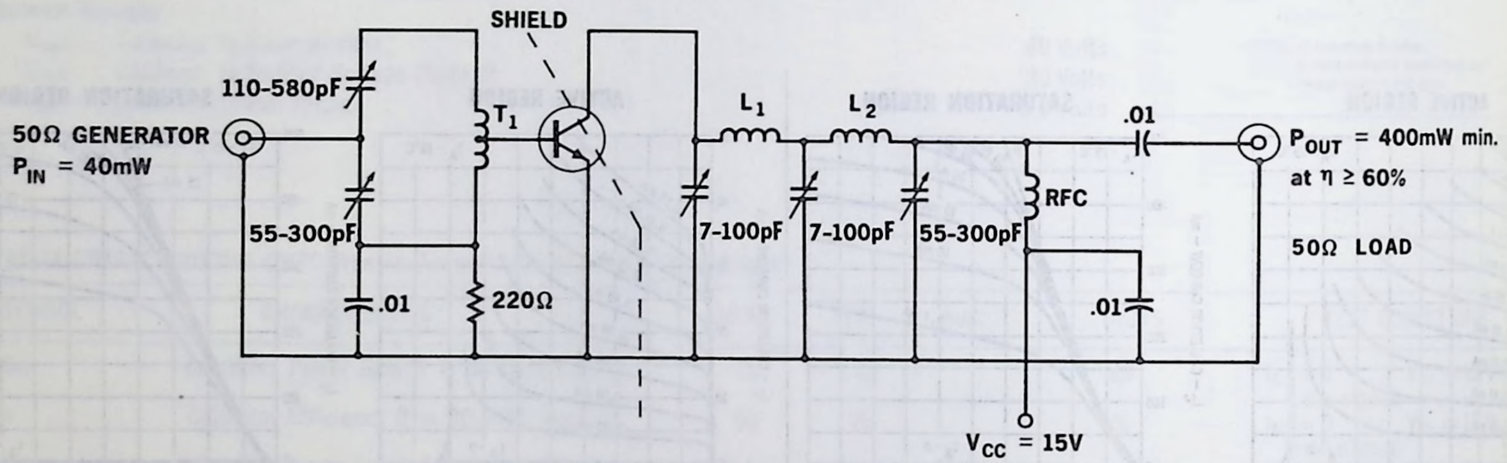
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



TYPICAL POWER IN VERSUS POWER OUT



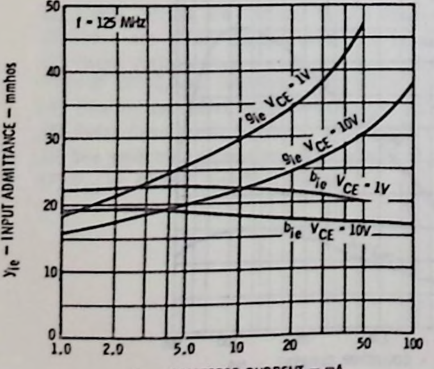
30MHz AMPLIFIER TEST CIRCUIT


SHIELD
110-580pF
50Ω GENERATOR
P_{IN} = 40mW
55-300pF
T_1
.01
220Ω
L_1
L_2
7-100pF
7-100pF
55-300pF
RFC
.01
.01
P_{OUT} = 400mW min.
at η ≥ 60%
50Ω LOAD
V_{CC} = 15V

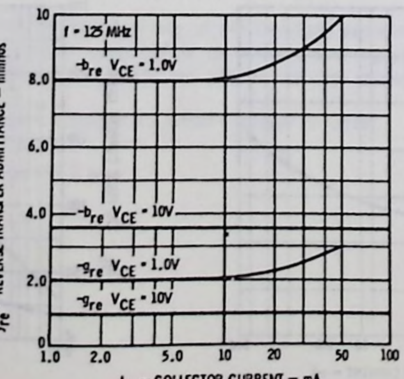
T_1 - 4 Turns no. 20 Wire, ¾" Dia. x ¼" Long, Midtapped.
L_1 and L_2 - 4 Turns no. 20 Wire, ½" Dia. x ¼" Long.
Variable Capacitors are Compression Mica.

R_G = 140Ω, R_L = 260Ω as seen by transistor.

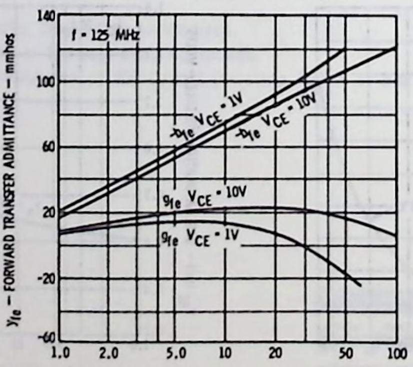
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT (OUTPUT SHORT CIRCUIT)



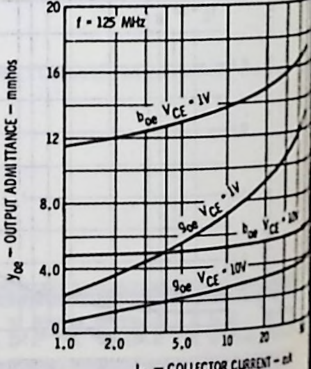
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT (INPUT SHORT CIRCUIT)



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT (OUTPUT SHORT CIRCUIT)



OUTPUT ADMITTANCE VE COLLECTOR CURRENT (INPUT SHORT CIRCUI

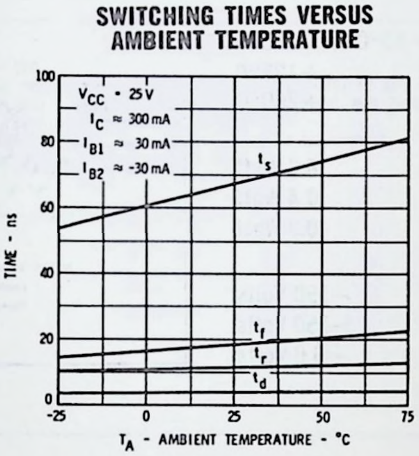


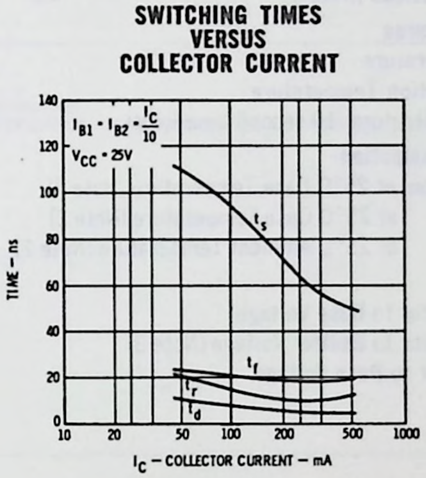
TYPICAL ELECTRICAL CHARACTERISTICS

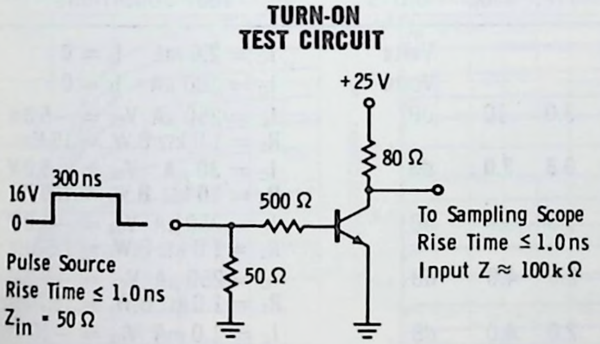
TYPICAL SMALL SIGNAL CHARACTERISTICS

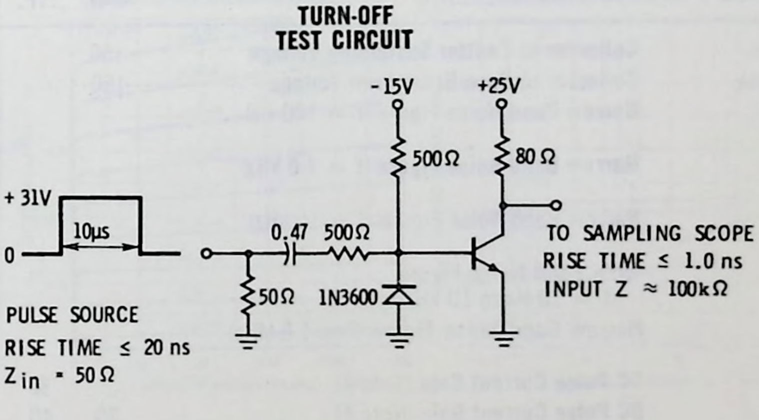
($f = 1$ kHz, $V_{CE} = 10$ V)

		2N4436		2N4437		
Symbol	Characteristic	$I_C = 10$ mA	50 mA	10 mA	50 mA	Units
h_{ie}	Input Resistance	460	350	950	880	Ohms
h_{oe}	Output Conductance	55	405	83	660	μmhos
h_{re}	Voltage Feedback Ratio	130	500	205	1500	$\times 10^{-6}$
h_{fe}	Small Signal Current Gain	90	97	170	220	


SWITCHING TIMES VERSUS AMBIENT TEMPERATURE


SWITCHING TIMES VERSUS COLLECTOR CURRENT


TURN-ON TEST CIRCUIT
+25 V
80 Ω
16V
300 ns
0
500 Ω
50 Ω
Pulse Source
Rise Time ≤ 1.0 ns
Z_in = 50 Ω
To Sampling Scope
Rise Time ≤ 1.0 ns
Input Z ≈ 100 kΩ


TURN-OFF TEST CIRCUIT
-15V
+25V
500 Ω
80 Ω
+31V
10μs
0
0.47
500 Ω
50 Ω
1N3600
PULSE SOURCE
RISE TIME ≤ 20 ns
Z_in = 50 Ω
TO SAMPLING SCOPE
RISE TIME ≤ 1.0 ns
INPUT Z ≈ 100 kΩ

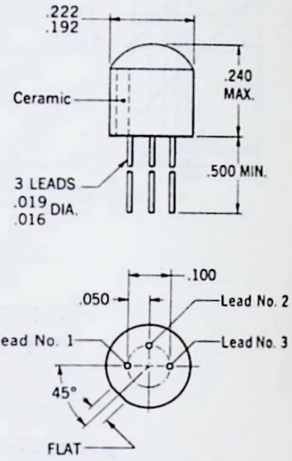
2N4888 • 2N4889

PNP LOW NOISE HIGH VOLTAGE AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTORS

- **VERY HIGH VOLTAGE (LV_{CEO}) -- 150 VOLTS (Min.)**
- **LOW NOISE FIGURE -- 3.0 dB (Max.) @ 1.0 kHz**
- **LOW OUTPUT CAPACITANCE (C_{obo}) -- 4.0 pF (Max.)**
- **HIGH BETA (h_{FE}) -- 80–300 @ 10 mA**
- **EXCELLENT BETA LINEARITY FROM 10 μA to 50 mA**

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 0.68 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Soldering Temperature (10 second time limit)	+260°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Note 2]	**0.8 Watt**
at 75°C Case Temperature [Note 2]	**0.4 Watt**
at 25°C Ambient Temperature [Note 2]	**0.3 Watt**
Maximum Voltages	
V_{CBO} Collector to Base Voltage	−150 Volts
V_{CEO} Collector to Emitter Voltage [Note 3]	−150 Volts
V_{EBO} Emitter to Base Voltage	−6.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4888 MIN.	2N4888 TYP.	2N4888 MAX.	2N4889 MIN.	2N4889 TYP.	2N4889 MAX.	UNITS	TEST CONDITIONS
V_{CEO}	**Collector to Emitter Sustaining Voltage**	−150			**−150**			**Volts**	**$I_C = 2.0$ mA $I_B = 0$**
BV_{CBO}	Collector to Base Breakdown Voltage	−150			−150			Volts	$I_C = 100\ \mu A$ $I_E = 0$
NF	Narrow Band Noise Figure (f = 100 Hz)					3.0	10	dB	$I_C = 250\ \mu A$ $V_{CE} = -5.0$ V $R_S = 1.0$ kΩ B.W. = 15 Hz
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**					**0.8**	**3.0**	**dB**	**$I_C = 30\ \mu A$ $V_{CE} = -5.0$ V** **$R_S = 10$ kΩ B.W. = 150 Hz**
NF	Narrow Band Noise Figure (f = 10 kHz)					1.5	3.0	dB	$I_C = 250\ \mu A$ $V_{CE} = -5.0$ V $R_S = 1.0$ kΩ B.W. = 1.5 kHz
NF	Wide Band Noise Figure (f = 10 Hz to 10 kHz)					2.0	4.0	dB	$I_C = 250\ \mu A$ $V_{CE} = -5.0$ V $R_S = 1.0$ kΩ B.W. = 15.7 kHz
NF	Narrow Band Noise Figure (f = 1.0 MHz)					2.0	4.0	dB	$I_C = 1.0$ mA $V_{CE} = -10$ V $R_S = 1.0$ kΩ B.W. = 2.0 kHz
h_{FE}	**DC Pulse Current Gain [Note 4]**		30		**60**	**135**			**$I_C = 100\ \mu A$ $V_{CE} = -10$ V**
h_{FE}	**DC Pulse Current Gain [Note 4]**	30	40		**70**	**150**			**$I_C = 1.0$ mA $V_{CE} = -10$ V**
h_{FE}	**DC Pulse Current Gain [Note 4]**	40	45	400	**80**	**150**	**300**		**$I_C = 10$ mA $V_{CE} = -10$ V**
C_{obo}	**Common-Base, Open Circuit Output Capacitance (f = 1.0 MHz)**		2.5	4.0		**2.5**	**4.0**	**pF**	**$V_{CB} = -20$ V $I_E = 0$**

* Planar is a patented Fairchild proce

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ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4888 MIN.	2N4888 TYP.	2N4888 MAX.	2N4889 MIN.	2N4889 TYP.	2N4889 MAX.	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		0.7	50		0.7	10	nA	$V_{CB} = -100$ V $I_E = 0$
I_{CBO} (65°C)	Collector Cutoff Current		0.01	2.5		0.01	0.5	μA	$V_{CB} = -100$ V $I_E = 0$
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 4]		−0.1	−0.5		−0.1	−0.5	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
BV_{EBO}	Emitter to Base Breakdown Voltage	−6.0			−6.0			Volts	$I_E = 10\mu A$ $I_C = 0$
I_{EBO}	Emitter Cutoff Current		0.4	50		0.4	10	nA	$V_{EB} = -4.0$ V $I_C = 0$
V_{BE} (on)	Pulsed Base Emitter On Voltage [Note 4]		−0.66	−0.8		−0.59	−0.7	Volts	$I_C = 1.0$ mA $V_{CE} = -10$ V
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 4]		−0.74	−0.9		−0.74	−0.9	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
C_{ibo}	Common-Base, Open-Circuit Input Capacitance		11	30		11	25	pF	$V_{EB} = -0.5$ V $I_C = 0$
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	1.5	1.8	8.0	**2.0**	**3.3**	**8.0**		$I_C = 1.0$ mA $V_{CE} = -10$ V

NOTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

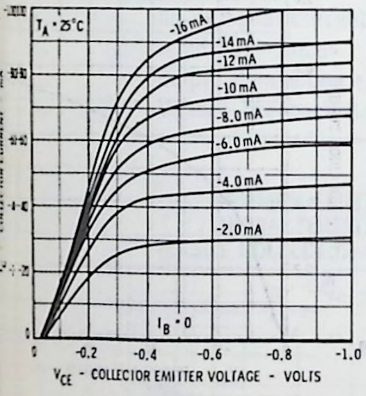
These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C).

This rating refers to a high current point where collector to emitter voltage is lowest.

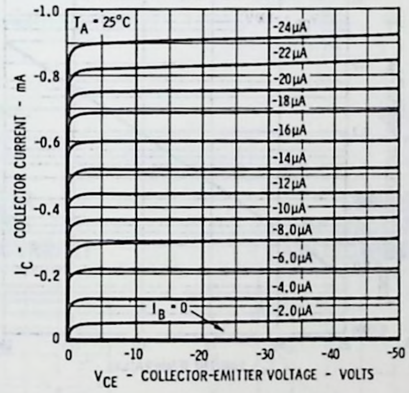
Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N4888
TYPICAL ELECTRICAL CHARACTERISTICS

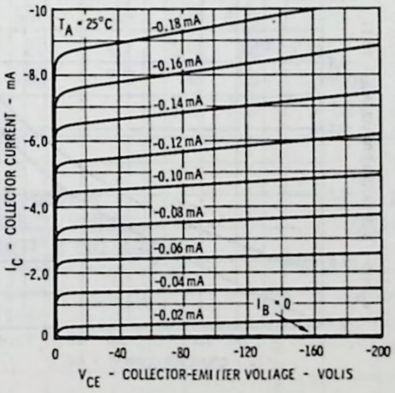
COLLECTOR CHARACTERISTICS



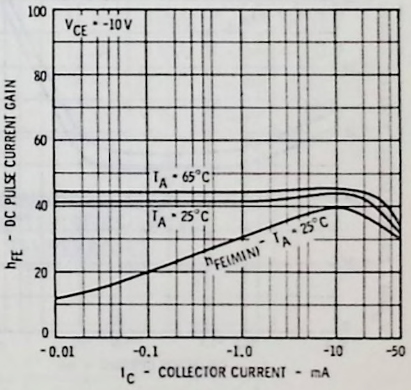
COLLECTOR CHARACTERISTICS



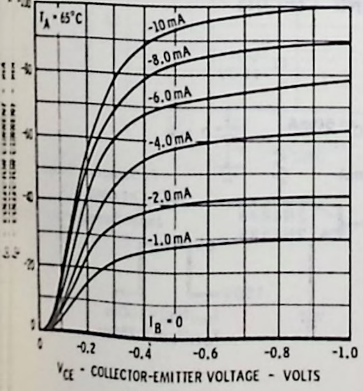
COLLECTOR CHARACTERISTICS



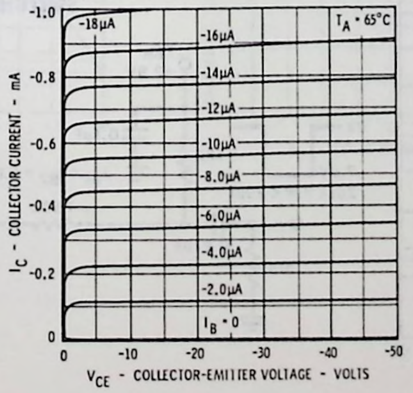
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



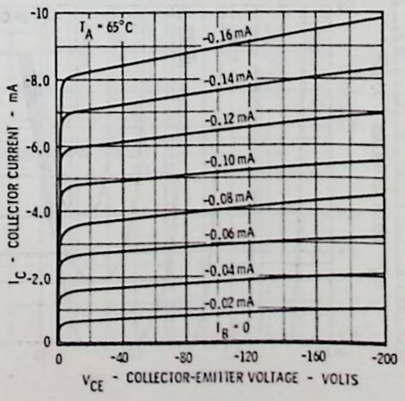
COLLECTOR CHARACTERISTICS



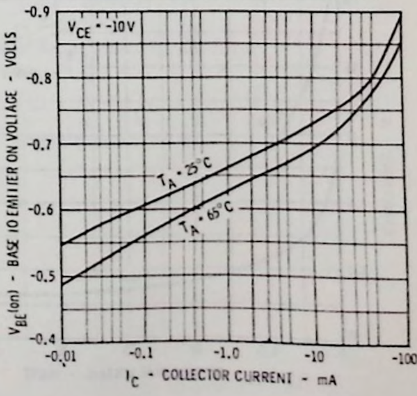
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



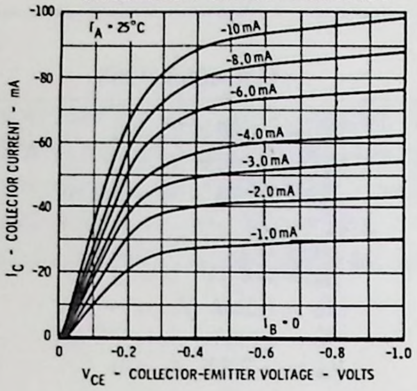
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



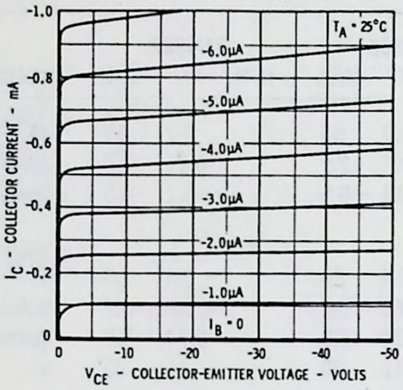
2N4889

TYPICAL ELECTRICAL CHARACTERISTICS

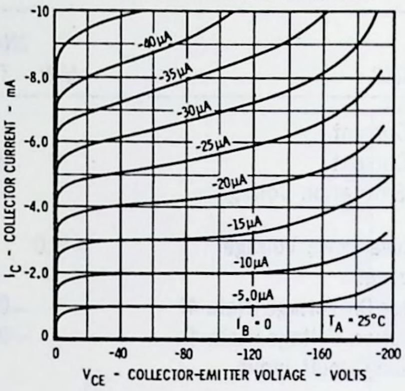
COLLECTOR CHARACTERISTICS



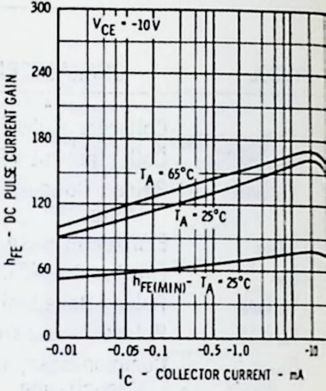
COLLECTOR CHARACTERISTICS



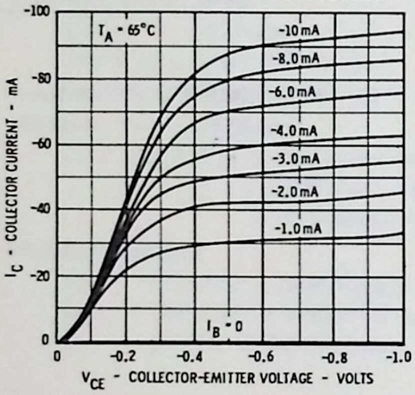
COLLECTOR CHARACTERISTICS



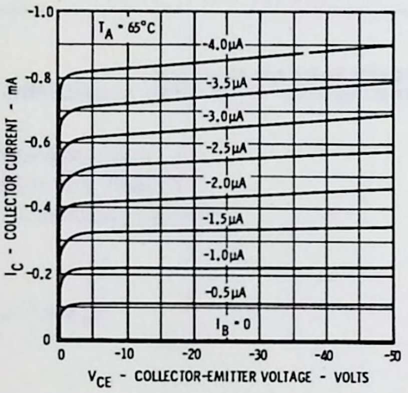
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



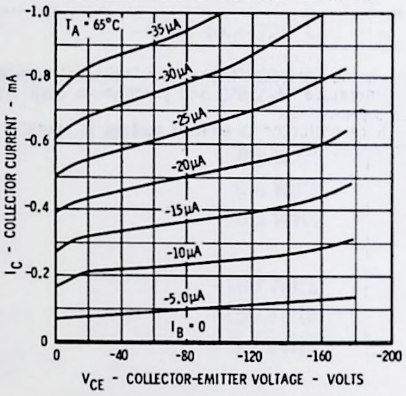
COLLECTOR CHARACTERISTICS



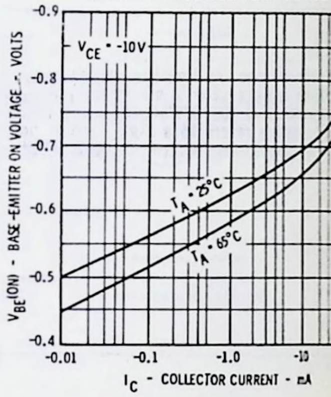
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS

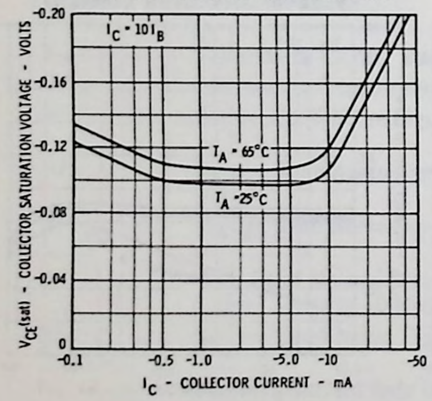


BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT

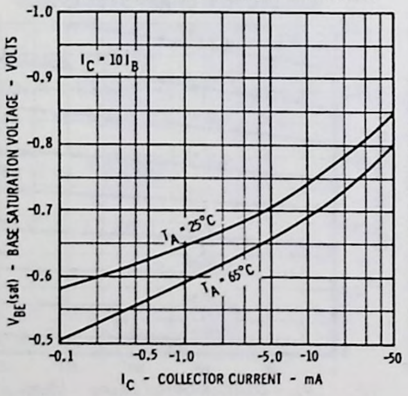


2N4888 • 2N4889

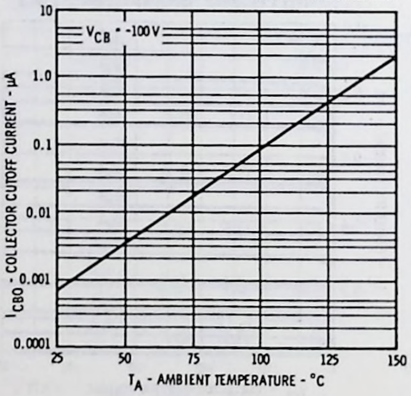
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



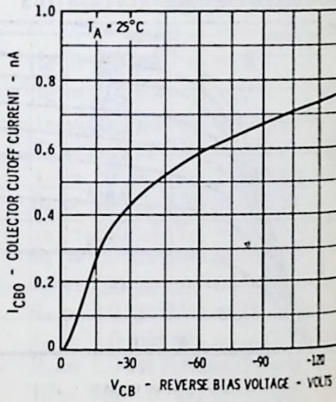
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



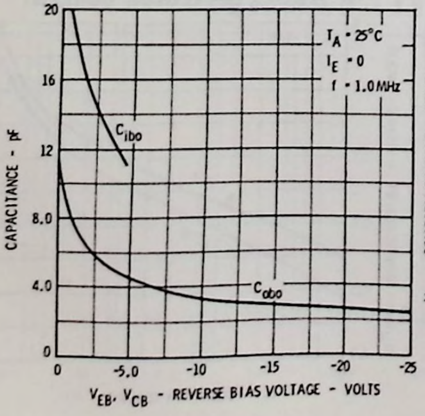
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



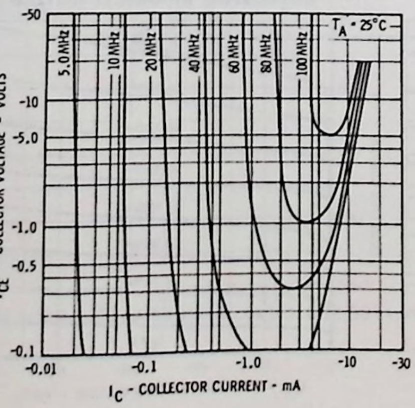
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



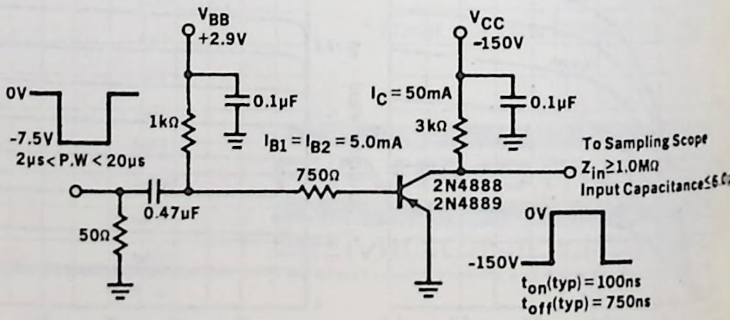
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGES



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

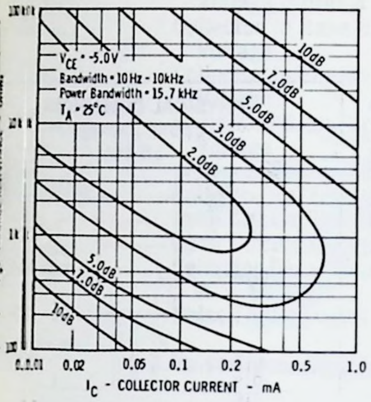


T_{on} — T_{off} SWITCHING CIRCUIT

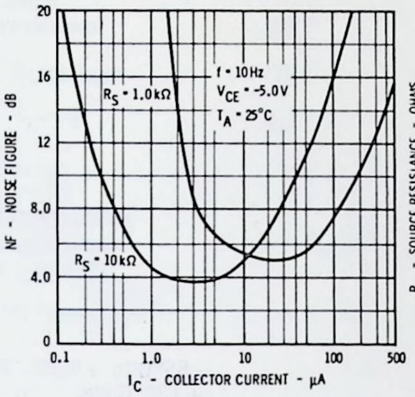

VBB
+2.9V
0V
-7.5V
2µs< P.W < 20µs
0.1µF
1kΩ
IB1 = IB2 = 5.0mA
0.47µF
50Ω
750Ω
VCC
-150V
IC = 50mA
0.1µF
3kΩ
2N4888
2N4889
To Sampling Scope
Zin≥1.0MΩ
Input Capacitance≤6.0
0V
-150V
ton(typ) = 100ns
toff(typ) = 750ns

2N4889
TYPICAL ELECTRICAL CHARACTERISTICS

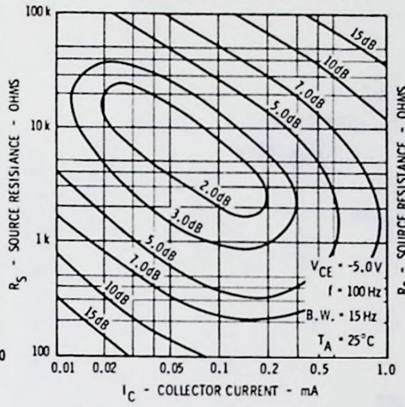
CONTOURS OF CONSTANT WIDE BAND NOISE FIGURE



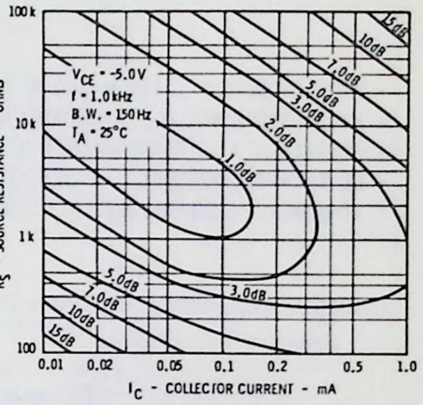
NOISE FIGURE VERSUS COLLECTOR CURRENT



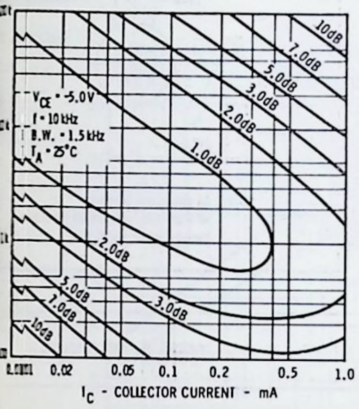
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



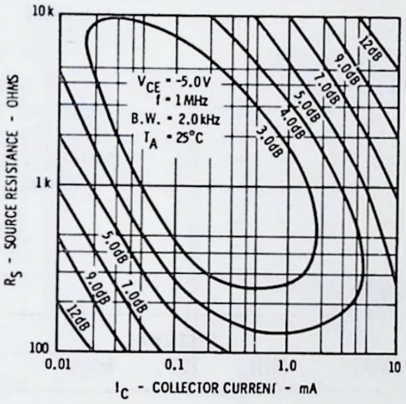
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



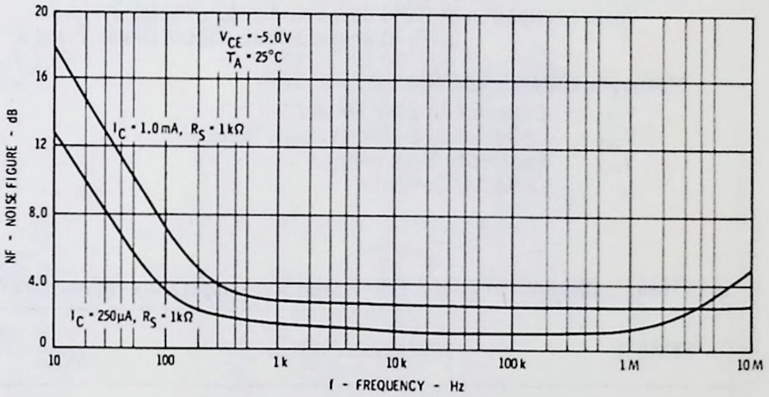
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



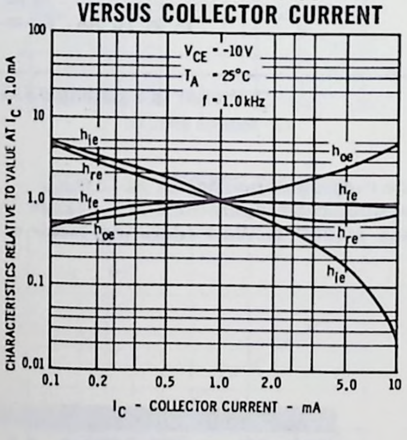
SPOT NOISE FIGURE VERSUS FREQUENCY



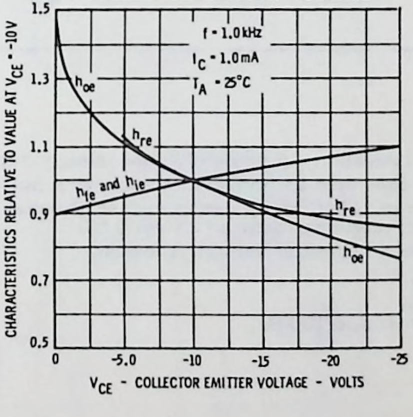
ALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	2N4888 MIN.	2N4888 TYP.	2N4888 MAX.	2N4889 MIN.	2N4889 TYP.	2N4889 MAX.	UNITS	TEST CONDITIONS
h_{fe}	Small Signal Current Gain	30	40	500	65	150	400		$I_C = 1.0$ mA $V_{CE} = -10$ V
h_{ie}	Input Resistance	0.75	1.2	20	1.7	5.0	12	kΩ	$I_C = 1.0$ mA $V_{CE} = -10$ V
h_{oe}	Output Conductance	1.4	2.5	40	3.0	10	25	μmhos	$I_C = 1.0$ mA $V_{CE} = -10$ V
h_{re}	Voltage Feedback Ratio		1.0			2.5	5.0	$\times 10^{-4}$	$I_C = 1.0$ mA $V_{CE} = -10$ V

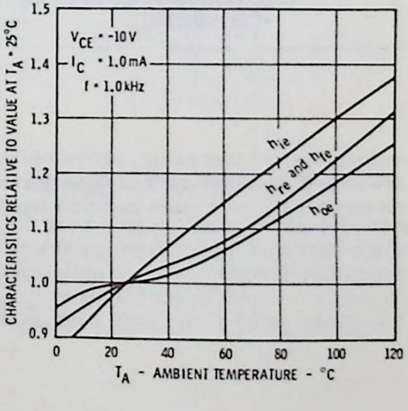
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



COMMON EMITTER CHARACTERISTICS VERSUS TEMPERATURE



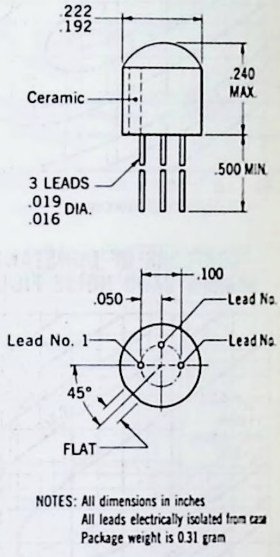
2N4916 • 2N4917

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH BETA (h_{FE}) -- 150 to 300 @ 10 mA**
- **HIGH FREQUENCY (f_T) -- 450 MHz Min. @ 10 mA**
- **EXCELLENT R.F. PERFORMANCE ($r_b'C_c$) -- 50 ps Max.**
- **LOW CAPACITANCE (C_{obo}) -- 4.5 pF Max.**
- **LOW NOISE (100 MHz N.F.) -- 6.0 dB Max.**

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 sec time limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	−30 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−30 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4916 MIN.	2N4916 TYP.	2N4916 MAX.	2N4917 MIN.	2N4917 TYP.	2N4917 MAX.	UNITS	TEST CONDITIONS
h_{FE}	**DC Current Gain**	40	70		**100**	**150**			**I_C = 100 μA** V_{CE} = −1.0V
h_{FE}	DC Current Gain	60	100		150	200			I_C = 1.0 mA V_{CE} = −1.0V
h_{FE}	**DC Pulse Current Gain** [Note 5]	70	150	200	**150**	**200**	**300**		**I_C = 10 mA** V_{CE} = −1.0V
h_{FE}	DC Pulse Current Gain [Note 5]	15	30		30	60			I_C = 50 mA V_{CE} = −1.0V
V_{CE} (sat)	Collector Saturation Voltage		−0.07	−0.13		−0.07	−0.13	Volts	I_C = 1.0 mA I_B = 0.1 mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		−0.1	−0.14		−0.1	−0.14	Volts	I_C = 10 mA I_B = 1.0 mA
V_{CE} (sat)	**Pulsed Collector Saturation Voltage** [Note 5]		−0.2	−0.3		**−0.2**	**−0.3**	**Volts**	**I_C = 50 mA** I_B = 5.0 mA
V_{BE} (sat)	Base Saturation Voltage		−0.65	−0.75		−0.65	−0.75	Volts	I_C = 1.0 mA I_B = 0.1 mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	−0.7	−0.77	−0.9	−0.7	−0.77	−0.9	Volts	I_C = 10 mA I_B = 1.0 mA
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]	−0.75	−0.88	−1.1	−0.75	−0.88	−1.1	Volts	I_C = 50 mA I_B = 5.0 mA
t_{on}	**Turn On Time** [Note 6]		20	40		**20**	**40**	**ns**	**I_C ≈ 50 mA** I_{B1} ≈ 5.0 mA
t_{off}	**Turn Off Time** [Note 6]		95	150		**95**	**150**	**ns**	**I_C ≈ 50 mA** I_{B1} ≈ 5.0 mA I_{B2} ≈ −5.0
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	4.0	5.5		**4.5**	**6.0**			**I_C = 10 mA** V_{CE} = −20 V

* Planar is a patented Fairchild pr

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) This rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.
(7) Power Bandwidth of 15.7 kHz with 3 dB points at 10 Hz and 10 kHz.

FAIRCHIL
SEMICONDUCTO
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATIO

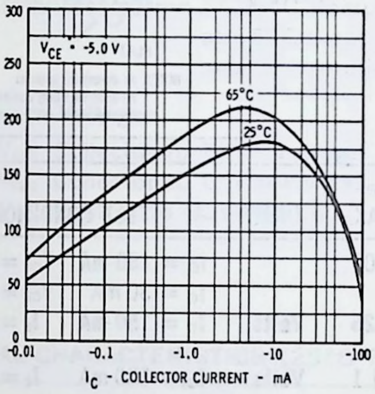
FAIRCHILD TRANSISTORS 2N4916 • 2N4917

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

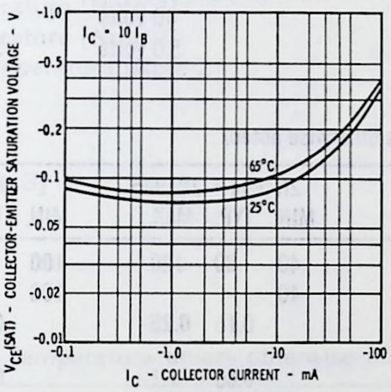
SYMBOL	CHARACTERISTIC	2N4916 MIN.	2N4916 TYP.	2N4916 MAX.	2N4917 MIN.	2N4917 TYP.	2N4917 MAX.	UNITS	TEST CONDITIONS
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	−30			−30			**Volts**	**I_C = 10 mA** $I_B = 0$ (pulsed)
BV_{CBO}	Collector to Base Breakdown Voltage	−30			−30			Volts	$I_C = 10\ \mu A$ $I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−30			−30			Volts	$I_C = 10\ \mu A$ $V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			Volts	$I_C = 0$ $I_E = 10\ \mu A$
I_{CES}	Collector Reverse Current			25			25	nA	$V_{CE} = -15$ V $V_{BE} = 0$
I_{CES} (65°C)	Collector Reverse Current			25			25	μA	$V_{CE} = -15$ V $V_{BE} = 0$
C_{obo}	**Open Circuit Output Capacitance**		2.2	4.5		**2.2**	**4.5**	**pF**	$I_E = 0$ **$V_{CB} = -10$V**
C_{ibo}	Open Circuit Input Capacitance		4.0	8.0		4.0	8.0	pF	$I_C = 0$ $V_{EB} = -0.5$ V
$r_{b'}C_c$	**Collector-Base Time Constant (f = 80 MHz)**			50			**50**	**ps**	**I_C = 10 mA** $V_{CE} = -20$ V
NF	**Noise Figure (f = 100 MHz)**		3.5	6.0		**3.5**	**6.0**	**dB**	**I_C = 1.0 mA** $V_{CE} = -5.0$ V **$R_S = 100\Omega$** BW = 15 MHz
NF	Noise Figure [Note 7]		2.5	4.0		2.5	4.0	dB	$I_C = 100\ \mu A$ $V_{CE} = -5.0$ V $R_S = 1.0\ k\Omega$

TYPICAL ELECTRICAL CHARACTERISTICS

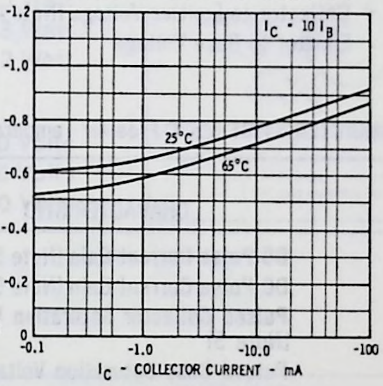
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



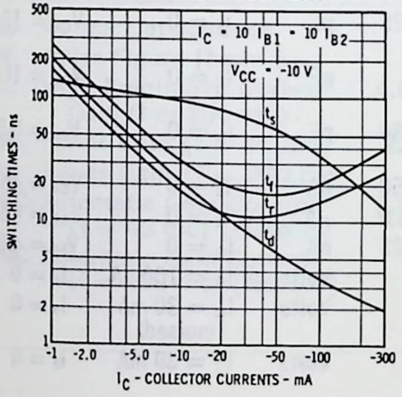
COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



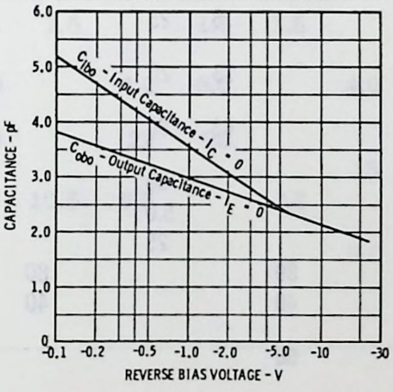
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



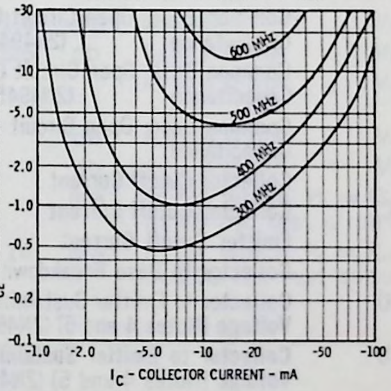
SWITCHING TIMES VERSUS COLLECTOR CURRENT



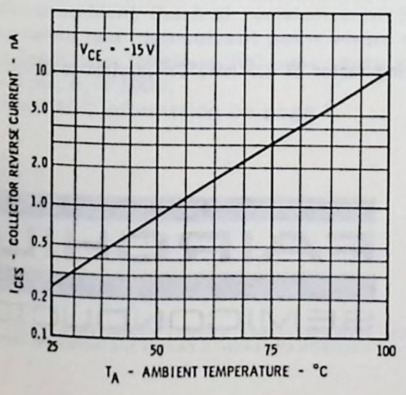
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



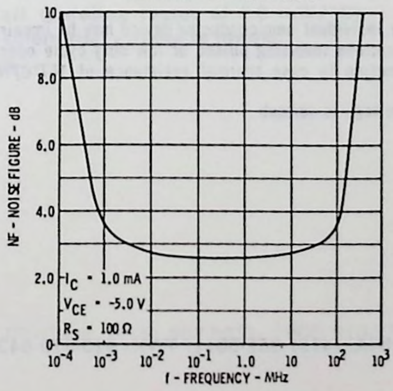
CONTOURS OF CONSTANT GAIN BANDWITH PRODUCT (f_T)



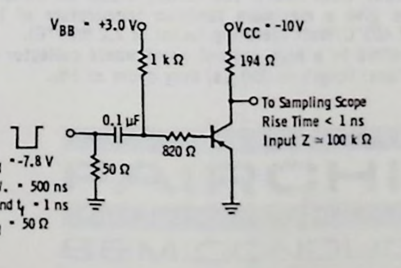
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



NOISE FIGURE VERSUS FREQUENCY



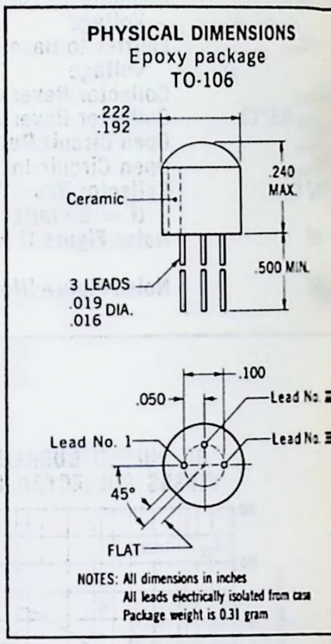
SWITCHING TIME TEST CIRCUIT



2N4944 • 2N4945 • 2N4946

NPN GENERAL PURPOSE TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS



- **LV_{CEO} — 60 Volts Min.**
- **h_{FE} — 100 Min. at 150 mA**
- **V_{CE} (sat) — 0.25 Volt Max. at 150 mA**

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperature

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation [Notes 2 and 3]

Total Dissipation at 25°C Case Temperature	0.6 Watt
at 25°C Ambient Temperature	0.22 Watt

Maximum Voltages		2N4944 2N4946	2N4945
V_{CBO}	Collector to Base Voltage	80 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	40 Volts	60 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N4944 • 2N4945			2N4946					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** [Note 5]	40	80	120	**100**	150	300		**$I_C = 150$ mA**	**$V_{CE} = 1.0$ V**
h_{FE}	DC Pulse Current Gain [Note 5]	40			100				$I_C = 30$ mA	$V_{CE} = 1.0$ V
V_{CE} (sat)	**Pulsed Collector Saturation Voltage** [Note 5]		0.15	**0.25**		0.10	**0.25**	**Volts**	**$I_C = 150$ mA**	**$I_B = 15$ mA**
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		0.85	1.1		0.85	1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0		15	3.0		15		$I_C = 50$ mA	$V_{CE} = 10$ V
C_{obo}	Common Base, Open Circuit Output Capacitance (2N4944 only)		16	25		16	25	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{obo}	Common Base, Open Circuit Output Capacitance (2N4945 only)		13	20				pF	$I_E = 0$	$V_{CB} = 10$ V
C_{ibo}	Common Base, Open Circuit Input Capacitance		63	80		63	80	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current			50			50	nA	$I_E = 0$	$V_{CB} = 40$ V
I_{CBO} (75°C)	Collector Cutoff Current			5.0			5.0	μA	$I_E = 0$	$V_{CB} = 40$ V
I_{EBO}	Emitter Cutoff Current			25			25	nA	$I_C = 0$	$V_{EB} = 4.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	80			80			Volts	$I_C = 100$ μA	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5] (2N4944 only)	40			40			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5] (2N4945 only)	**60**						**Volts**	**$I_C = 30$ mA**	**$I_B = 0$**
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_C = 0$	$I_E = 10$ μA

* Planar is a patented Fairchild

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 167°C/Watt (derating factor of 6.0 mW/°C); junction to ambient resistance of 455°C/Watt (derating factor of 2.2 mW/°C).
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATI

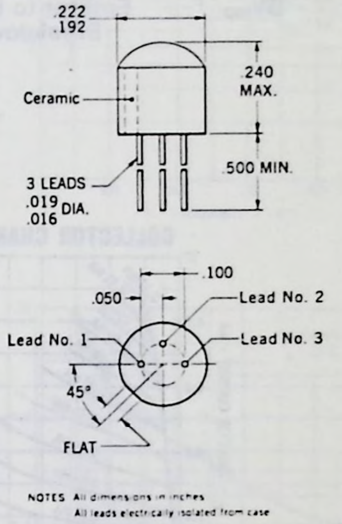
SE5001 · SE5002 · SE5003

NPN RF-AGC AMPLIFIERS

SILICON PLANAR TRANSISTORS

e SE5001, SE5002, and SE5003 are NPN silicon PLANAR transistors designed specifically for mmercial RF-IF-AGC applications. They feature high power gain, low noise, and excellent forrd AGC characteristics in a solid package designed to give maximum mechanical support to e transistor chip.

PHYSICAL DIMENSIONS
Epoxy package
TO-106



NOTES: All dimensions in inches
All leads electrically isolated from case

SOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Operating Junction Temperature	**125°C** Maximum
Storage Temperature	**−55°C** to **+125°C**
Soldering Temperature	**260°C** Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Note 2]	**0.5** Watt
at 65°C Case Temperature [Note 2]	**0.3** Watt
at 25°C Ambient Temperature [Note 2]	**0.2** Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	**40** Volts
V_{CEO}	Collector to Emitter Voltage [Note 3]	**40** Volts
V_{EBO}	Emitter to Base Voltage	**4.0** Volts

ECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

		SE5001			SE5002			SE5003					
Symbol	Characteristics	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	TEST CONDITIONS	
C_{ob}	Output Capacitance		**1.1**	**1.6**		**1.1**	**1.6**		**1.1**	**1.6**	pf	$I_E = 0$	$V_{CB} = 10$ V
NF	Noise Figure [Note 5]								**4.0**	**5.5**	db	$I_C = 4.0$ mA	$V_{CE} = 10$ V
h_{fe}	High Frequency Current Gain (f = 100 mc)	**4.0**	**6.0**		**4.0**	**6.0**		**4.0**	**6.0**			$I_C = 4.0$ mA	$V_{CE} = 10$ V
PG_1	Power Gain (f = 45 mc)	**22**	**28**		**22**	**28**					db	$I_C = 4.0$ mA	$V_{CE} = 10$ V
PG_2	Power Gain (f = 200 mc)							**15**	**18**		db	$I_C = 4.0$ mA	$V_{CE} = 10$ V
AGC_1	Automatic Gain Control (f = 45 mc) [Note 6]	**8.0**		**10.5**	**9.5**		**12**				mA	I_C for which $P_G = P_{G1}$ −30 db in 45 mc test circuit	
AGC_2	Automatic Gain Control (f = 200 mc) [Note 6]							**9.0**		**14**	mA	I_C for which $P_G = P_{G2}$ −30 db in 200 mc test circuit	

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
Rating refers to a high-current point where collector-to-emitter voltage is lowest.
Pulse Conditions: length = 300 μsec; duty cycle = 1%.
f = 200 mc; $R_S = 100\Omega$.
Additional AGC information on page 2.

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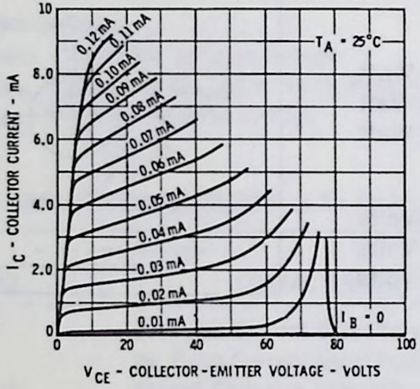
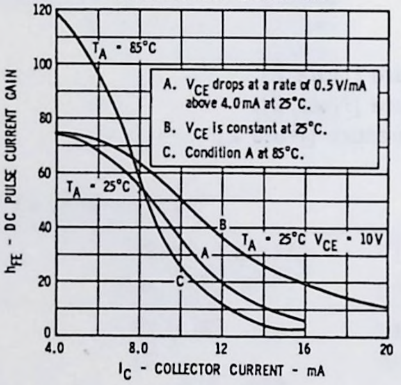
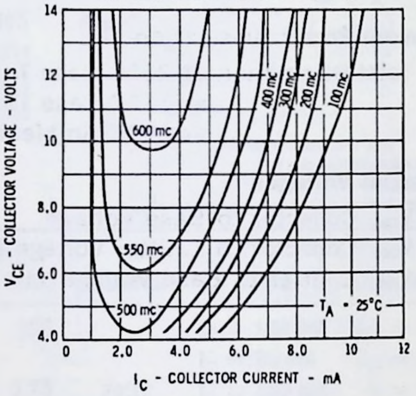
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

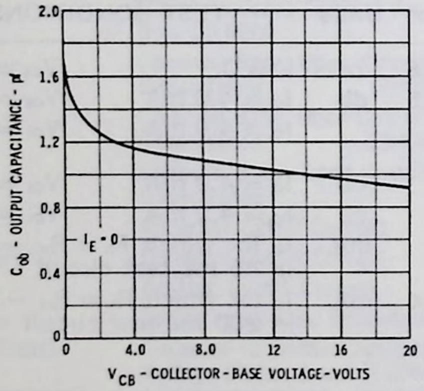
		SE5001			SE5002			SE5003				
Symbol	Characteristics	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 4]	30	70		30	70		30	70			$I_C = 4.0$ mA $V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current			500			500			500	nA	$I_E = 0$ $V_{CB} = 20$ V
I_{CBO} (65°C)	Collector Cutoff Current			5.0			5.0			5.0	μA	$I_E = 0$ $V_{CB} = 20$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40			40			40			Volts	$I_C = 100$ μA $I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 3 and 4]	40			40			40			Volts	$I_C = 3.0$ mA $I_B = 0$ (Pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			4.0			Volts	$I_E = 100$ μA $I_C = 0$

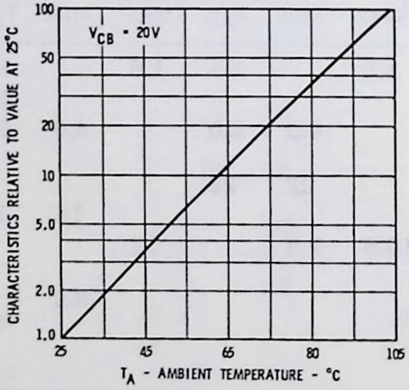
TYPICAL ELECTRICAL CHARACTERISTICS

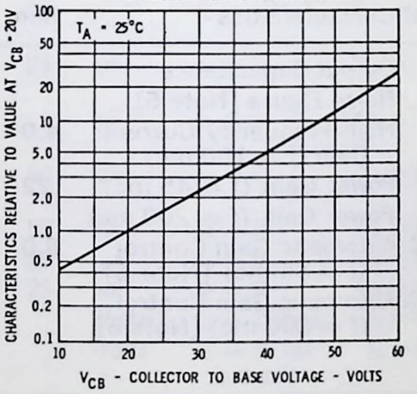

COLLECTOR CHARACTERISTICS

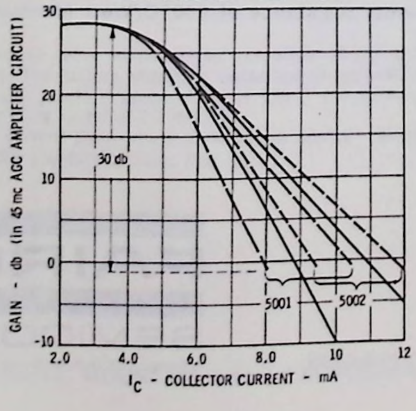

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

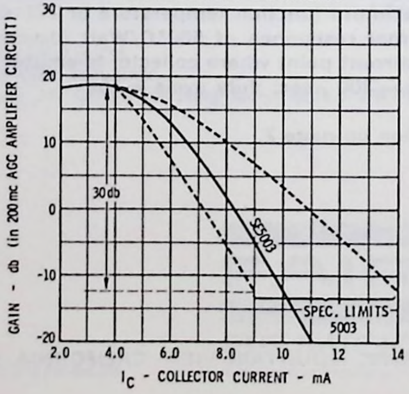

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)


OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE


NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE


NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE


TYPICAL GAIN VERSUS COLLECTOR CURRENT

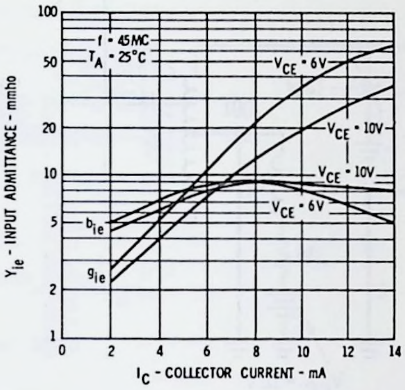

TYPICAL GAIN VERSUS COLLECTOR CURRENT

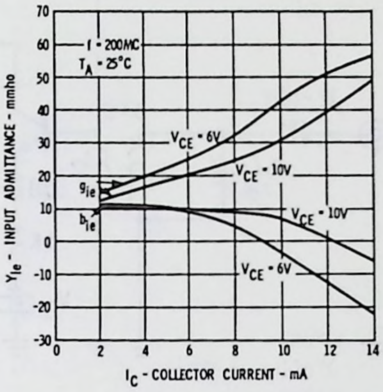
TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

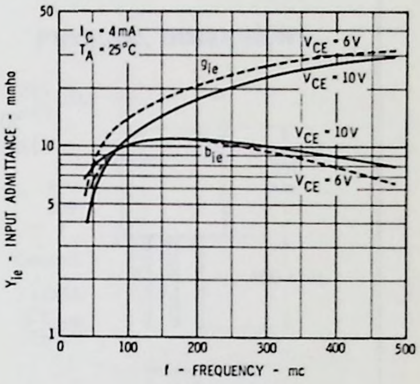
SE5001 • SE5002	SE5003	SE5001 • SE5002 • SE5003
45 mc	200 mc	vs. FREQUENCY
vs. COLLECTOR CURRENT	vs. COLLECTOR CURRENT	

y_{ie}

Input Admittance
(output short circuit)

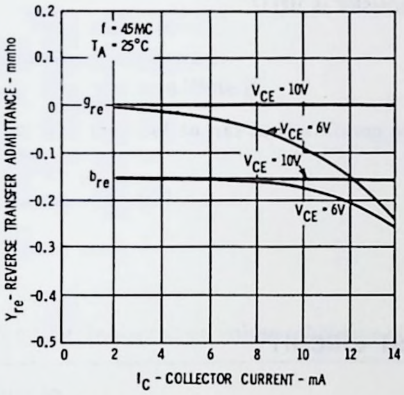


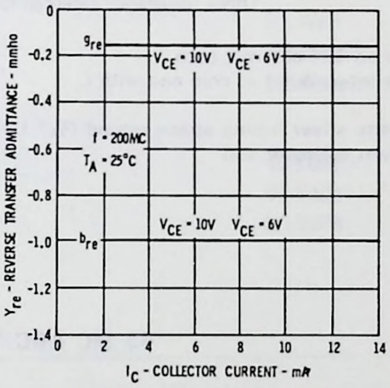


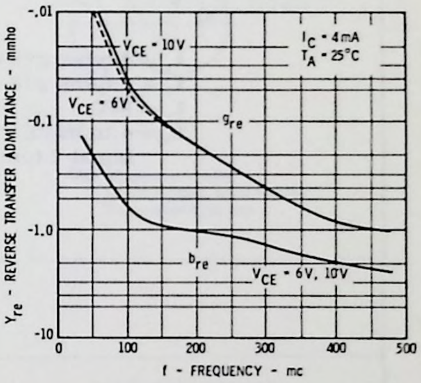


y_{re}

Reverse
Transfer Admittance
(input short circuit)

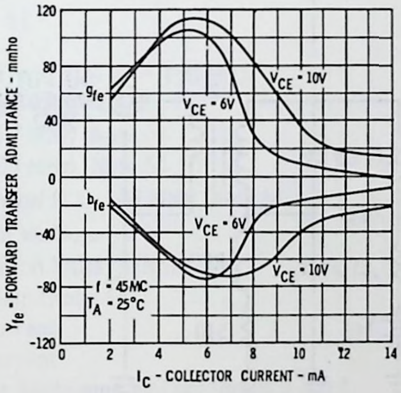


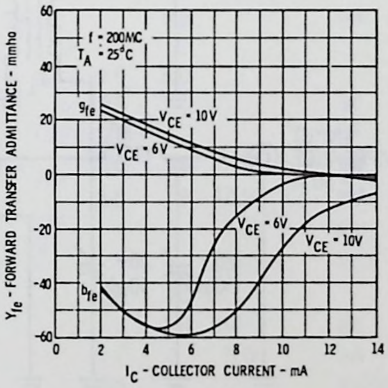


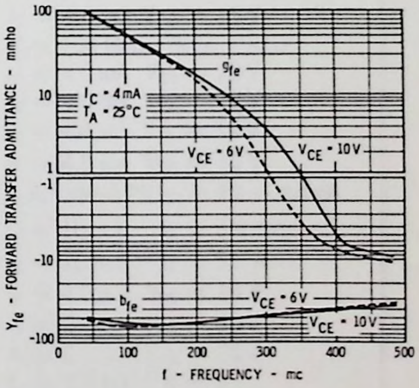


y_{fe}

Forward
Transfer Admittance
(output short circuit)

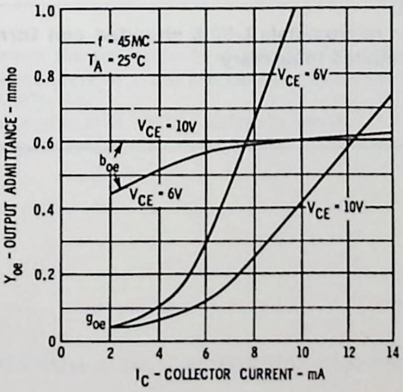


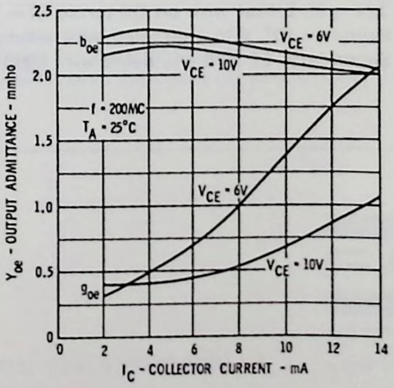


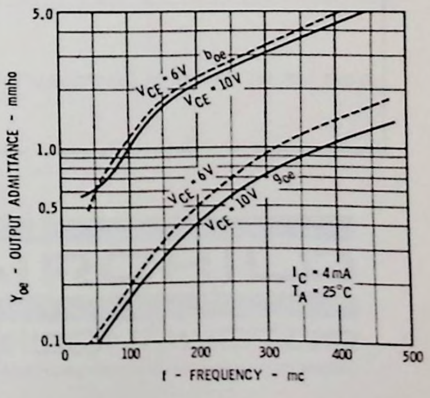


y_{oe}

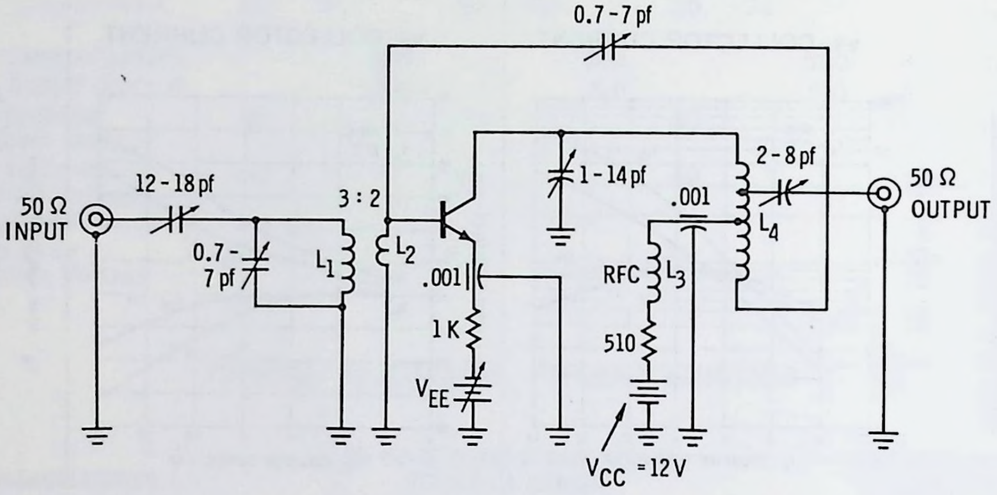
Output Admittance
(input short circuit)







200 MC AGC TEST CIRCUIT

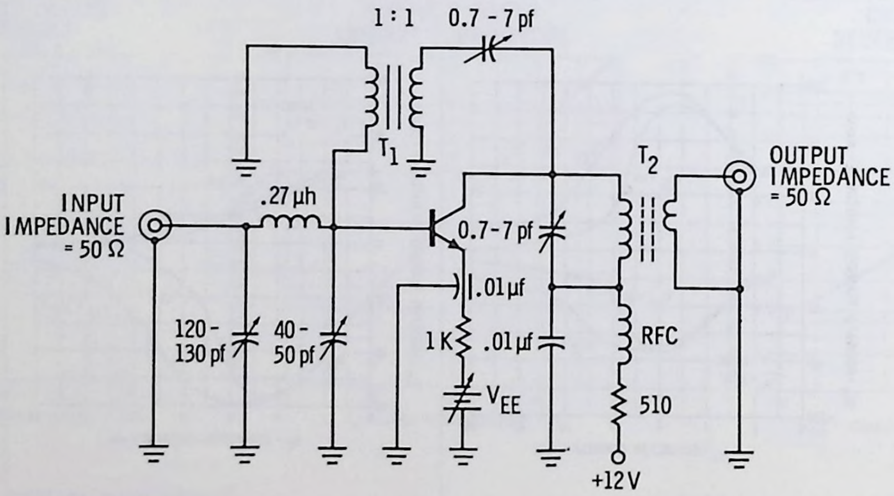


0.7-7 pf
50 Ω
INPUT
12-18 pf
0.7-7 pf
L_1
3 : 2
L_2
.001
1 K
V_{EE}
1-14 pf
2-8 pf
.001
RFC
L_3
510
L_4
50 Ω
OUTPUT
V_{CC} = 12 V

Input impedance referred to transistor is 100 Ω.

L_1 = 3 turns #18 wire on ¼" ceramic core
L_2 = 2 turns #18 wire interwound at cold end with L_1
L_3 = RFC
L_4 = 4 turns .076" diam. silver tubing space wound (⅜" I.D., no core). Output tap at ½ turn from collector end ground tap at 2 turns from collector end

45 MC AGC TEST CIRCUIT



1 : 1
0.7 - 7 pf
T_1
T_2
OUTPUT IMPEDANCE = 50 Ω
INPUT IMPEDANCE = 50 Ω
.27 µh
0.7-7 pf
.01 µf
120-130 pf
40-50 pf
1 K
.01 µf
V_{EE}
RFC
510
+12 V

T_1: 12T #32 bifilar wire on Q2 toroid ($\mu = 115$)
T_2: Primary: 10T #36 enameled wire wound on micrometals L-52-6 shielded coil form
Secondary: 2T #36 enameled wire tightly coupled to primary

SE5006
NPN RF AMPLIFIER
SILICON PLANAR* TRANSISTOR

LOW FEEDBACK CAPACITANCE -- C_{obo} = 1.6 pF Max.
HIGH POWER GAIN -- PG @ 100 MHz = 20 dB Min.
HIGH BREAKDOWN VOLTAGE -- LV_{CEO} = 40 V Min.
LOW NOISE FIGURE -- NF @ 100 MHz = 5.5 dB Typ.
FORWARD AGC CHARACTERISTIC

anar is a patented Fairchild process.

SOLUTE MAXIMUM RATINGS [Notes 1 and 2]

Maximum Temperatures

Operating Junction Temperature	125°C
Storage Temperature	−55°C to +125°C
Soldering Temperature	260°C

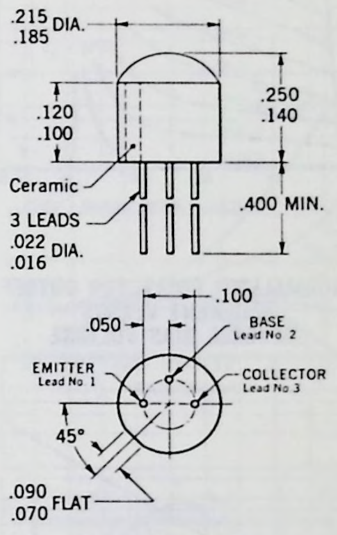
Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Note 2]	0.5 Watt
at 65°C Case Temperature [Note 2]	0.3 Watt
at 25°C Ambient Temperature [Note 2]	0.2 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage [Note 3]	40 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
C_{obo}	**Output Capacitance**		**1.1**	**1.6**	**pF**	**$I_E = 0$ $V_{CB} = 10$ V**
NF	**Noise Figure** [Note 5]		**5.5**		**dB**	**$I_C = 4.0$ mA $V_{CC} = 15$ V** f = 100 MHz $R_S = 100\,\Omega$
h_{fe}	High Frequency Current Gain (f = 100 MHz)	4.0	6.0			$I_C = 4.0$ mA $V_{CE} = 10$ V
PG	**Power Gain (f = 455 kHz)** [Note 5]	**35**			**dB**	**$I_C = 4.0$ mA $V_{CC} = 12$ V**
PG	**Power Gain (f = 10.7 MHz)** [Note 5]	**28**			**dB**	**$I_C = 4.0$ mA $V_{CC} = 12$ V**
PG	**Power Gain (f = 100 MHz)** [Note 5]	**20**	**26**		**dB**	**$I_C = 4.0$ mA $V_{CC} = 15$ V**
AGC	**Automatic Gain Control (f = 100 MHz)** [Note 5]	**6.0**	**9**	**10.5**	**mA**	**I_C for which $PG_{AGC} = PG - 30$ dB**
V_{CE}(sat)	Collector Saturation Voltage			2.0	Volts	$I_C = 10$ mA $I_B = 5.0$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage [Note 4]			0.98	Volt	$I_C = 10$ mA $I_B = 5.0$ mA
h_{FE}	DC Pulse Current Gain [Note 4]	30	70			$I_C = 4.0$ mA $V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current		1.0	50	nA	$I_E = 0$ $V_{CB} = 20$ V
I_{CBO} (65°C)	Collector Cutoff Current			5.0	μA	$I_E = 0$ $V_{CB} = 20$ V
LV_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 3 and 4]	**40**			**Volts**	**$I_C = 3.0$ mA $I_B = 0$** (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	$I_C = 0$ $I_E = 100$ μA

TES:
These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
Rating refers to a high-current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μsec; duty cycle = 1%.
See Test Circuit.

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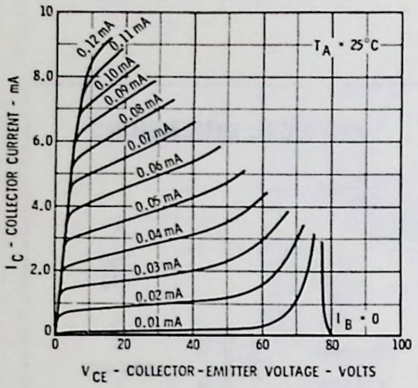
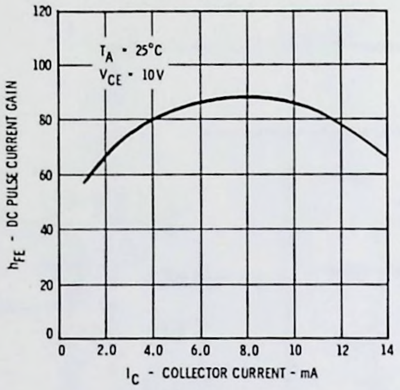
TYPICAL ELECTRICAL CHARACTERISTICS

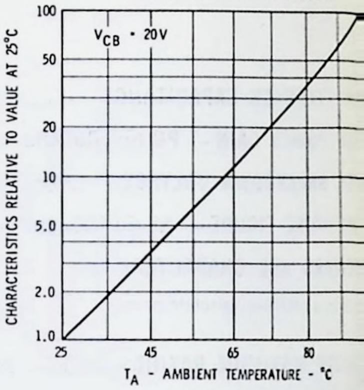
COLLECTOR CHARACTERISTICS



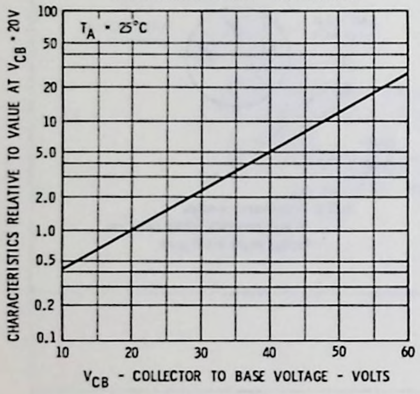
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



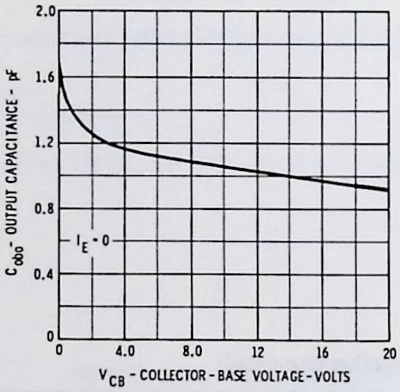
NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



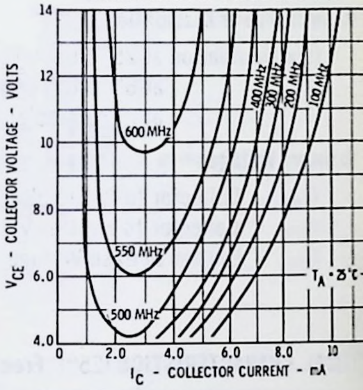
NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



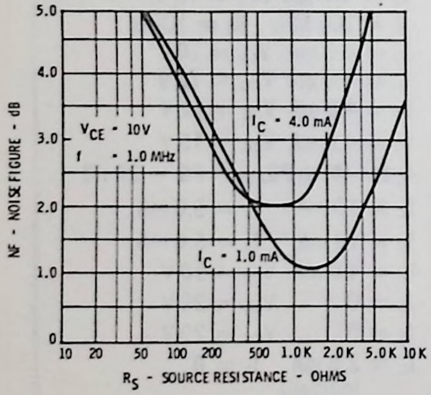
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



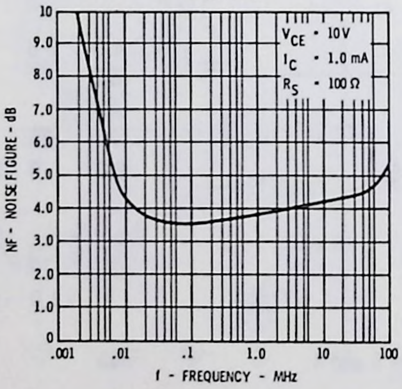
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



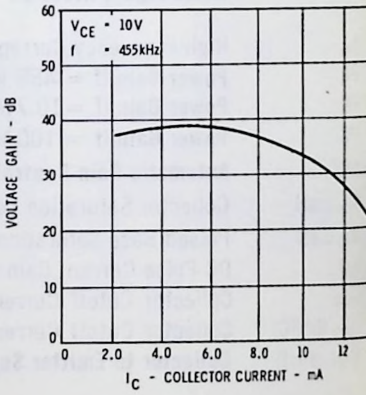
NARROW BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



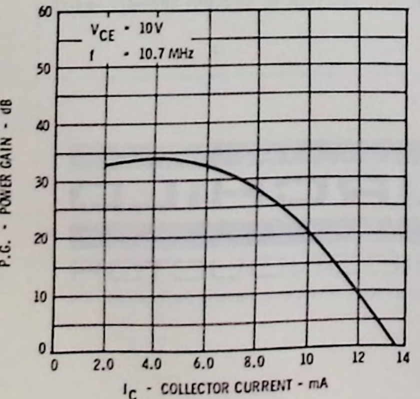
NOISE FIGURE VERSUS FREQUENCY



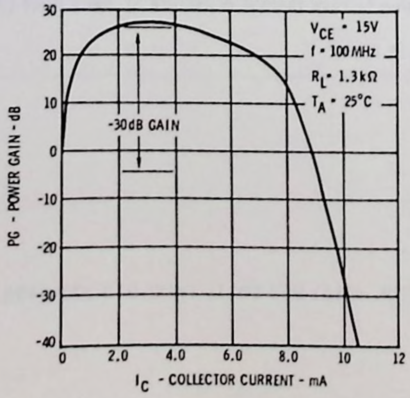
VOLTAGE GAIN VERSUS COLLECTOR CURRENT



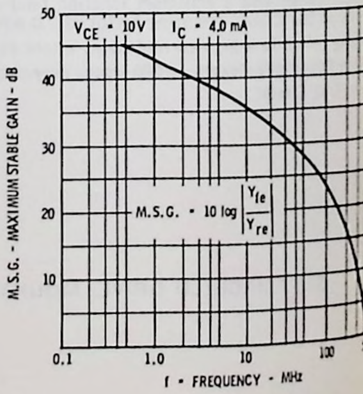
POWER GAIN VERSUS COLLECTOR CURRENT



POWER GAIN VERSUS COLLECTOR CURRENT



MAXIMUM STABLE GAIN VERSUS FREQUENCY

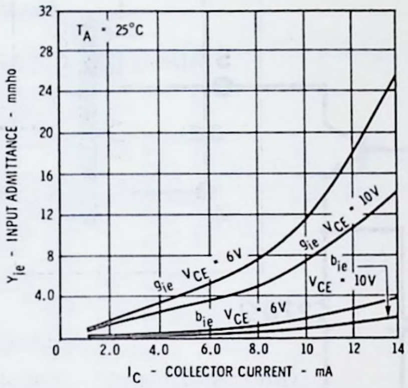


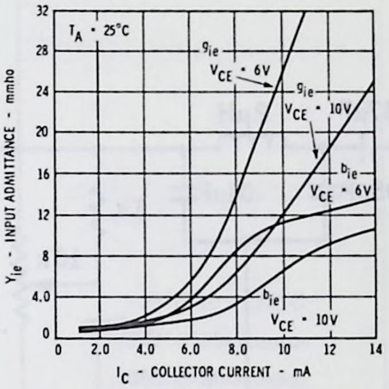
TYPICAL SMALL SIGNAL COMMON EMITTER "Y" PARAMETERS

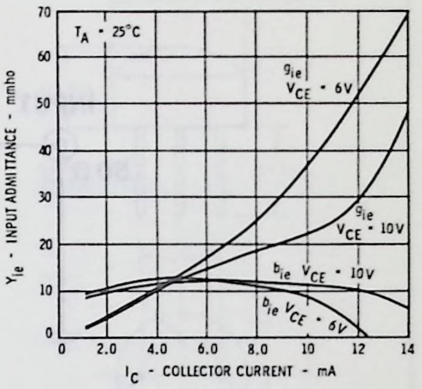
455 kHz | 10.7 MHz | 100 MHz

vs. COLLECTOR CURRENT | vs. COLLECTOR CURRENT | vs. COLLECTOR CURRENT

ie
utt Admittance
tput short circuit)







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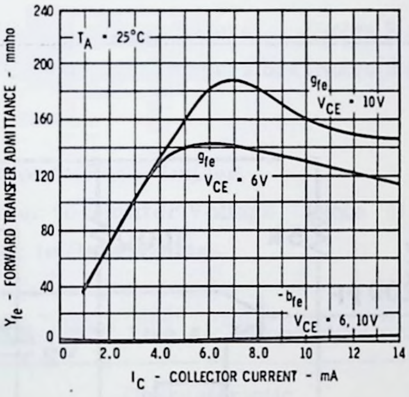

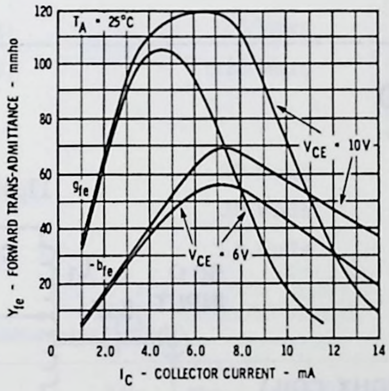

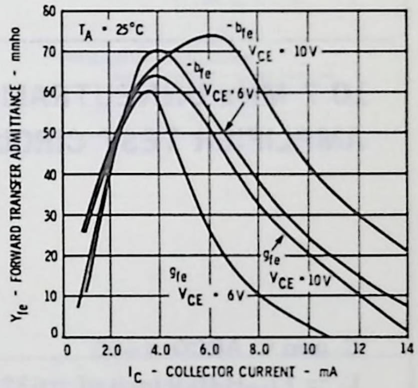

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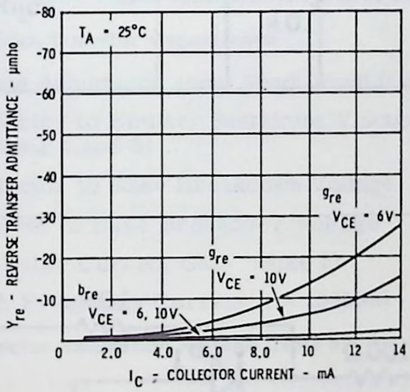

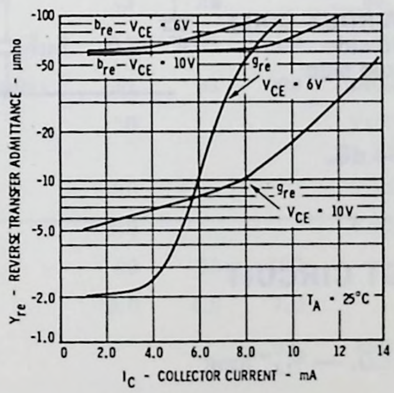

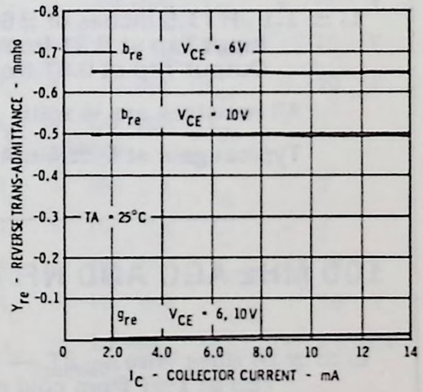

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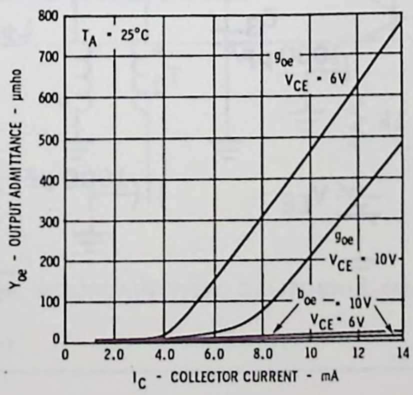
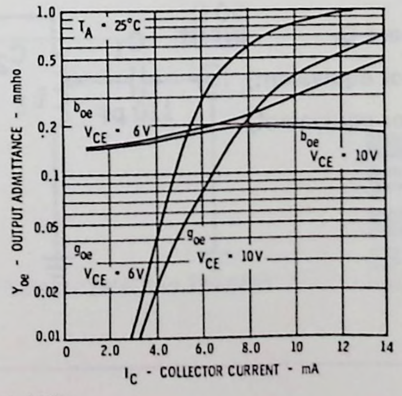
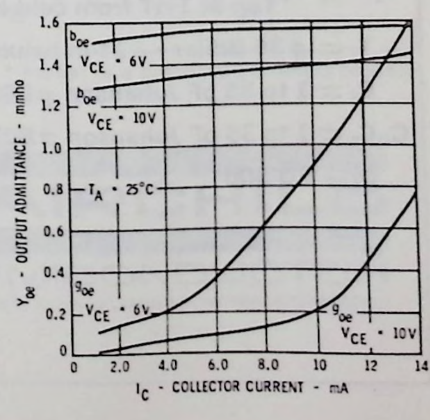
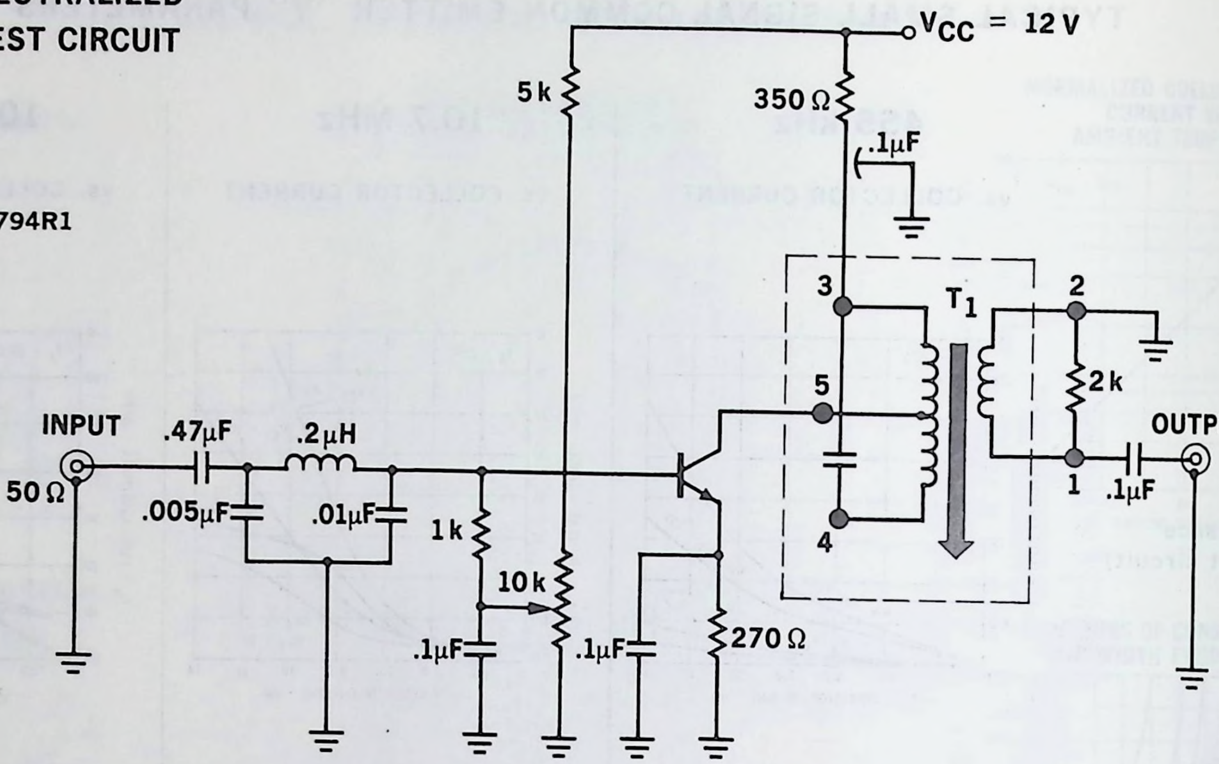






455 kHz UNNEUTRALIZED AMPLIFIER TEST CIRCUIT

T_1 = T.R.W. #17794R1


VCC = 12 V
5 k
350 Ω
.1µF
3
T1
2
5
2 k
OUTPUT
INPUT
.47µF
.2µH
50 Ω
.005µF
.01µF
1 k
10 k
1
.1µF
4
.1µF
.1µF
270 Ω

10.7 MHz UNNEUTRALIZED AMPLIFIER TEST CIRCUIT

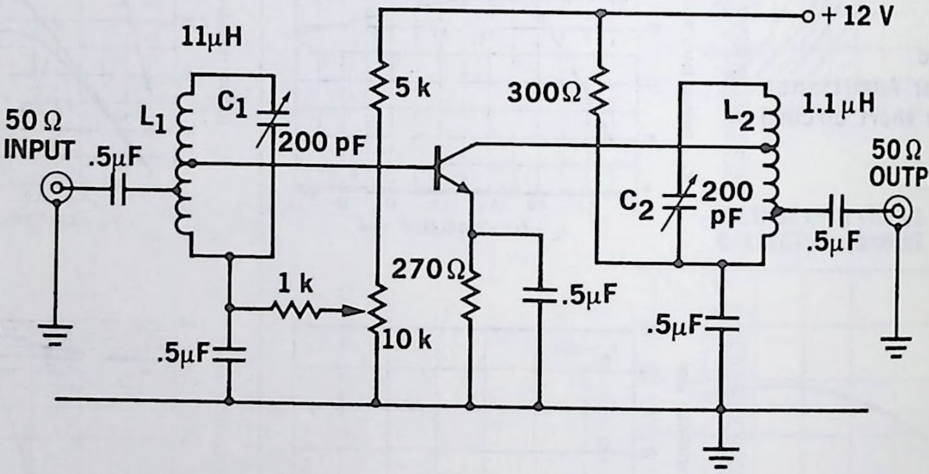
C_1 and C_2 ARCO #465

L_1 = 11 µH (0.9 inch of #632 AIRDUX COIL)
Input Tap at 2.9T from cold side
Output Tap at 3.66T from cold side

L_2 = 1.1 µH (1.5 inches of #608 AIRDUX COIL)
Input Tap at 2.3T from cold side
Output Tap at 0.5T from cold side

All resistors are ½ watt.

Typical gain at I_C = 4 mA is 34 dB.


+12 V
11µH
C1
L1
200 pF
5 k
300Ω
L2
1.1 µH
50 Ω INPUT
.5µF
C2
200 pF
50 Ω OUTPUT
.5µF
270Ω
1 k
.5µF
10 k
.5µF
.5µF

100 MHz AGC AND NF TEST CIRCUIT

L_1 = #14 Buss Wire — 3T — 3/8" I.D. — 5/12" long
Tap at 1½T from cold end

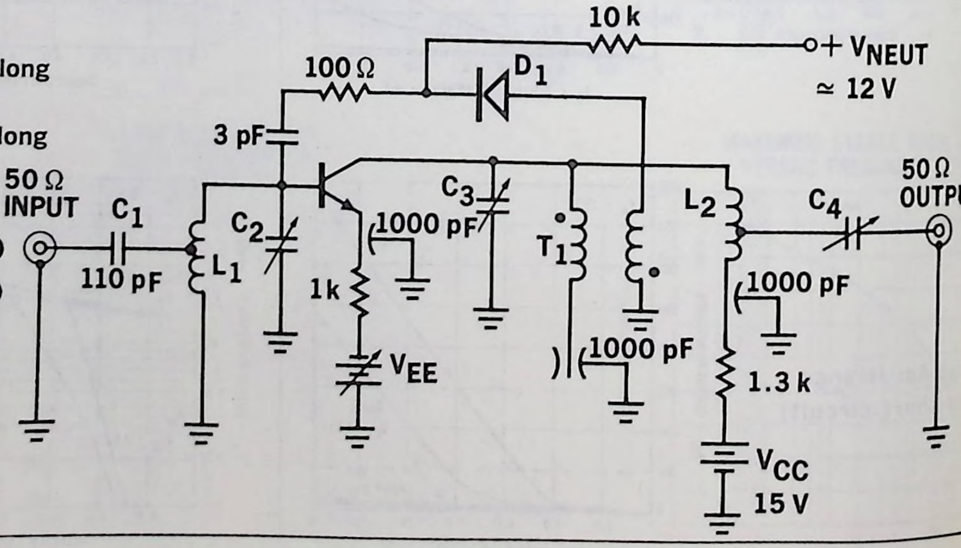
L_2 = #18 enameled — 5T — 3/8" I.D. — 5/16" long
Tap at 1½T from cold end

T_1 = #36 Bifilar — 1T in balum core Q_3

C_2 = 1 to 35 pF Johanson #803 (or equivalent)

C_3,C_4 = 1 to 35 pF Johanson #803 (or equivalent)

D_1 — FD 300


10 k
+ VNEUT ≃ 12 V
100 Ω
D1
3 pF
C3
L2
C4
50 Ω OUTPUT
50 Ω INPUT
C1
C2
1000 pF
T1
110 pF
L1
1 k
1000 pF
VEE
1000 pF
1.3 k
VCC 15 V

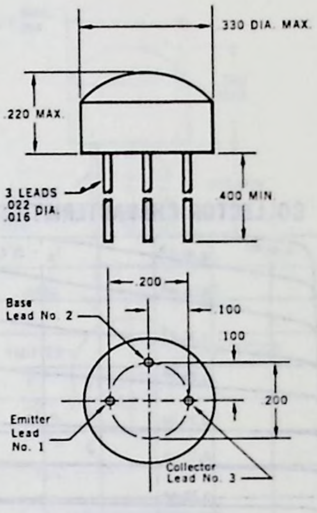
SE5025

NPN IF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- OPTIMIZED FOR FINAL VIDEO IF AMPLIFIER
- LOW C_{re} = 1.0 pF MAX.
- LOW g_{oe} = 200 μmho MAX.
- HIGH 45 MHz POWER GAIN = 25 dB MIN.
- HIGH LV_{CEO} = 30 V MIN.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.5 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 sec time limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.5 Watt
at 25°C Free Air Temperature	(Notes 2 and 3)	0.25 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
G_{pe}	**Power Gain, Fixed Neutralization (f = 45MHz)**	25	28		dB	I_C = 10 mA V_{CE} = 10 V
C_{re}	**Reverse Transfer Capacitance**	0.6	0.85	1.0	pF	I_E = 0 V_{CB} = 10 V
g_{oe}	**Output Admittance, Input Short Circuit (f = 45 MHz)**	30	90	200	μmho	I_C = 10 mA V_{CE} = 10 V
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30			Volts	I_C = 1.0 mA (pulsed) I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	I_C = 100 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_E = 10 μA I_C = 0
h_{FE}	DC Pulse Current Gain (Note 5)	20	35	100		I_C = 10 mA V_{CE} = 10 V
h_{fe}	High Frequency Current (f = 100MHz)	3.0	4.5	7.0		I_C = 10 mA V_{CE} = 10 V
V_{CE}(sat)	**Collector Saturation Voltage (Note 5)**			0.6	Volts	I_C = 20 mA (pulsed) I_B = 1.0 mA
I_{CEO}	Collector Cutoff Current			1.0	μA	I_B = 0 V_{CE} = 30 V
I_{CBO}	Collector Cutoff Current			50	nA	I_E = 0 V_{CB} = 30 V

* Planar is a patented Fairchild process.

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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

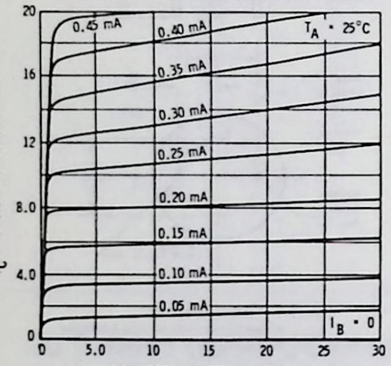
(3) These ratings give a maximum junction temperature of 125°C and junction-to-case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction-to-ambient thermal resistance of 400°C/Watt (derating factor of 2.5 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

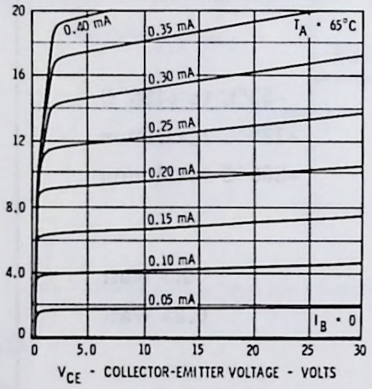
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

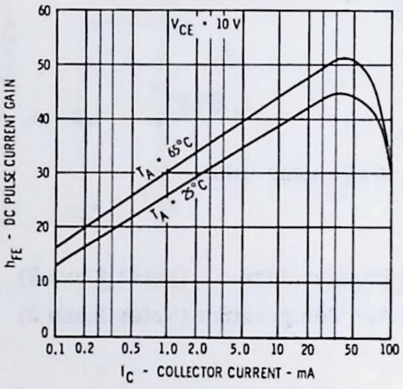
COLLECTOR CHARACTERISTICS



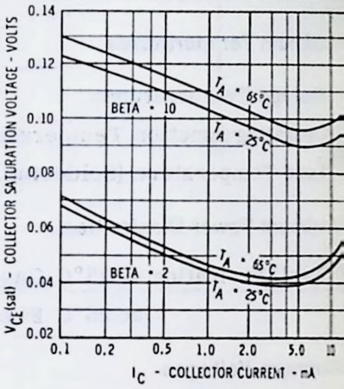
COLLECTOR CHARACTERISTICS



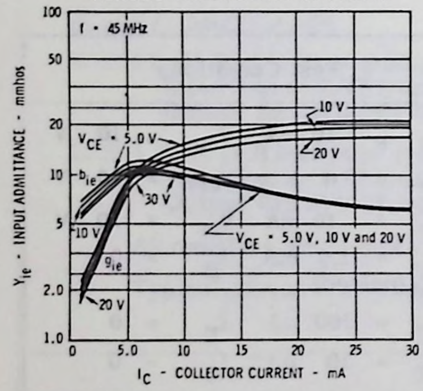
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



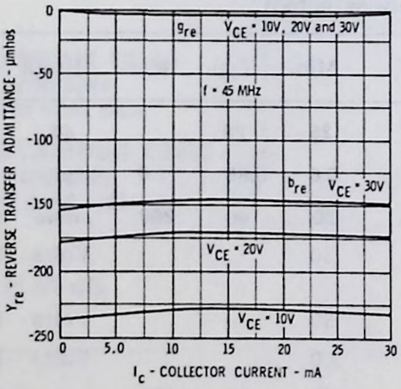
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



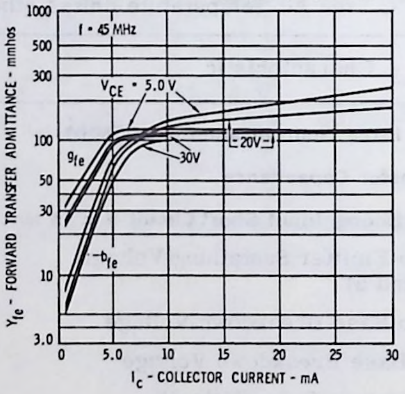
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT



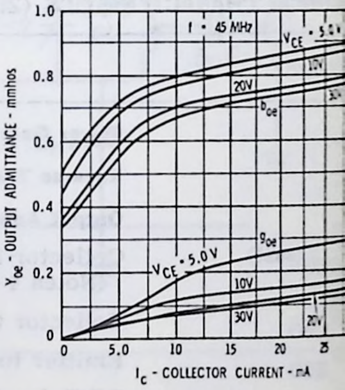
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT



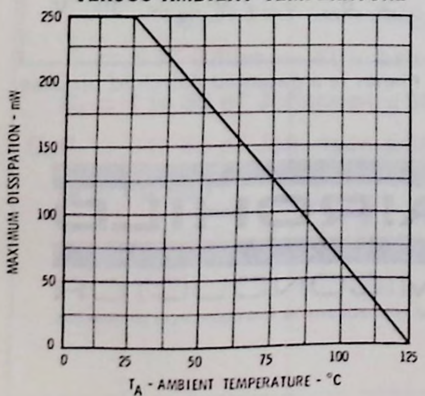
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT



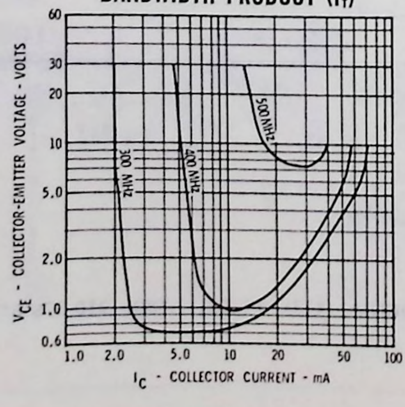
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT



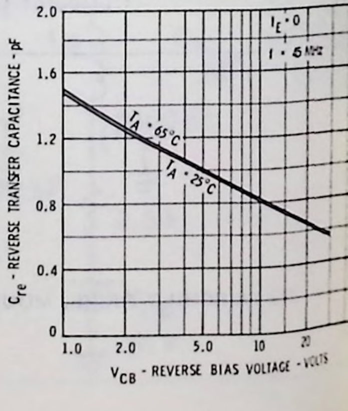
MAXIMUM POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



REVERSE TRANSFER CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



2N5040 · 2N5041

PNP HIGH CURRENT AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

EXCELLENT BETA LINEARITY . . . . $\frac{h_{FE} @ 500\ mA}{h_{FE} @ 150\ mA} = 0.75$ (Min.)

LOW SATURATION VOLTAGE . . . . $V_{CE}(sat) = 0.45$ V (typ.) @ $I_C = 1.0A$, $I_B = 33$ mA
. . . . $V_{CE}(sat) = 0.20$ V (typ.) @ $I_C = 500$ mA, $I_B = 50$ mA

HIGH BREAKDOWN VOLTAGE . . . . $LV_{CEO} = 40$ V (min.) @ $I_C = 30$ mA

COMPLEMENTARY WITH NPN 2N3567

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

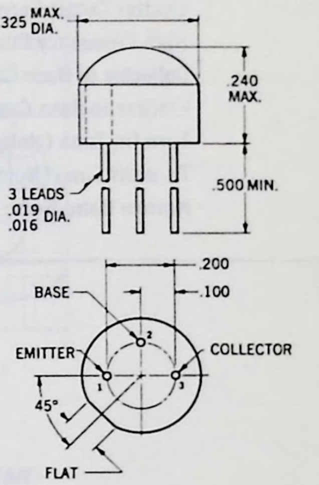
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.8 Watt
at 25°C Free Air Temperature (Notes 2 and 3)	0.3 Watt

Maximum Voltages		**2N5040**	**2N5041**
V_{CBO}	Collector to Base Voltage	25 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	25 Volts	40 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts	5.0 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTIC	2N5040 MIN.	2N5040 TYP.	2N5040 MAX.	2N5041 MIN.	2N5041 TYP.	2N5041 MAX.	UNITS	TEST CONDITIONS	
$\frac{_{FE2}}{_{FE1}}$	**DC Pulse Current Gain Ratio** (Note 5)		0.5		**0.75**	**0.85**			**h_{FE1}@I_C=150 mA** **h_{FE2}@I_C=500 mA**	**$V_{CE} = -1.0$ V** **$V_{CE} = -1.0$ V**
$_{FE1}$	**DC Pulse Current Gain** (Note 5)	30	170		**40**	**75**	**150**		**I_C=150 mA**	**$V_{CE} = -1.0$ V**
$_{FE2}$	**DC Pulse Current Gain** (Note 5)	20	75		**30**	**65**			**I_C=500 mA**	**$V_{CE} = -1.0$ V**
$_{FE}$	DC Pulse Current Gain (Note 5)	20	200		30	85	225		I_C=10 mA	$V_{CE} = -1.0$ V
$_{CEO}$(sust)	**Collector to Emitter Sustaining Voltage** (Note 4)	−25			**−40**			**Volts**	**I_C=30 mA (pulsed)**	**I_B=0**
V_{CBO}	Collector to Base Breakdown Voltage	−25			−40			Volts	I_C=100 μA	I_E=0
V_{EBO}	Emitter to Base Breakdown Voltage	−4.0			−5.0			Volts	I_C=0	I_E=10 μA
$_{CE}$(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.09	−0.25		−0.09	−0.25	Volt	I_C=150 mA	I_B=15 mA
$_{CE}$(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		−0.4	−1.0		**−0.2**	**−0.5**	**Volt**	**I_C=500 mA**	**I_B=50 mA**
$_{CE}$(sat)	**Pulsed Collector Saturation Voltage** (Note 5)					**−0.45**	**−1.3**	**Volts**	**I_C=1.0 A**	**I_B=33 mA**
$_{BE}$(on)	Pulsed Base Emitter on Voltage (Note 5)		−0.69	−0.85		−0.69	−0.75	Volt	I_C=20 mA	$V_{CE} = -5.0$ V
$_{BE}$(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.82	−1.1		−0.82	−1.1	Volts	I_C=150 mA	I_B=15 mA
$_{BE}$(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.9	−1.2		−0.85	−1.1	Volts	I_C=500 mA	I_B=50 mA
$_{BE}$(sat)	Pulsed Base Saturation Voltage					−0.95	−1.2	Volts	I_C=1.0 A	I_B=33 mA

*Planar is a patented Fairchild process.

ES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C).
This rating refers to a high current point where collector to emitter voltage is lowest.
Pulse conditions: length = 300 μs; duty cycle = 1%.
See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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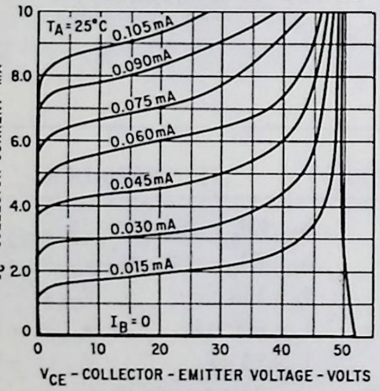
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

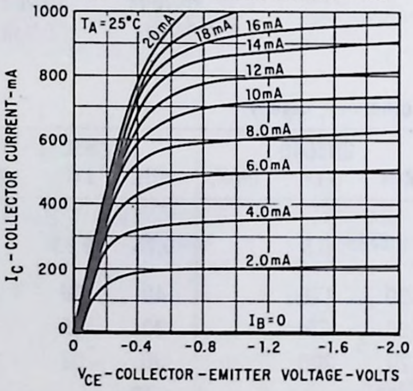
SYMBOL	CHARACTERISTIC	2N5040 MIN.	2N5040 TYP.	2N5040 MAX.	2N5041 MIN.	2N5041 TYP.	2N5041 MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	Collector Cutoff Current		0.1	50				nA	$I_C = 0$	$V_{CB} = -15$ V
I_{CBO}	Collector Cutoff Current					0.1	50	nA	$I_C = 0$	$V_{CB} = -30$ V
I_{CBO}(65°C)	Collector Cutoff Current		0.01	1.0				μA	$I_C = 0$	$V_{CB} = -15$ V
I_{CBO}(65°C)	Collector Cutoff Current					0.01	1.0	μA	$I_C = 0$	$V_{CB} = -30$ V
I_{EBO}	Emitter Cutoff Current					0.01	50	nA	$I_C = 0$	$V_{EB} = -4.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	0.8	2.0		1.0	2.0			$I_C = 50$ mA	$V_{CE} = -10$ V
c_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		15	35		15	35	pF	$I_E = 0$	$V_{CB} = -10$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		75	120		75	120	pF	$I_C = 0$	$V_{EB} = -0.5$ V
t_{on}	Turn On Time (Note 6)		23			30		ns	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA
t_{off}	Turn Off Time (Note 6)		200			250		ns	$I_C \approx 500$ mA	$I_{B1} = I_{B2} \approx 50$ mA
NF	Narrow Band Noise Figure (f = 1.0 kHz)		1.0			1.0		dB	$I_C = 200$ μA	$V_{CE} = -5.0$ V $R_S = 1.0$ kΩ

TYPICAL ELECTRICAL CHARACTERISTICS
(2N5041 only)

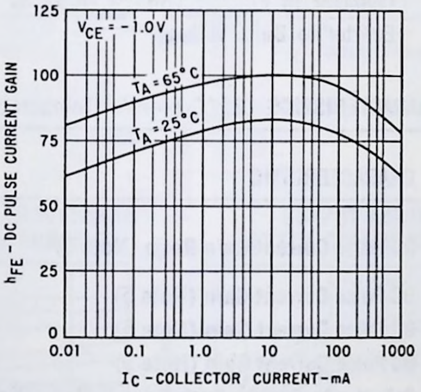
ACTIVE REGION COLLECTOR CHARACTERISTICS



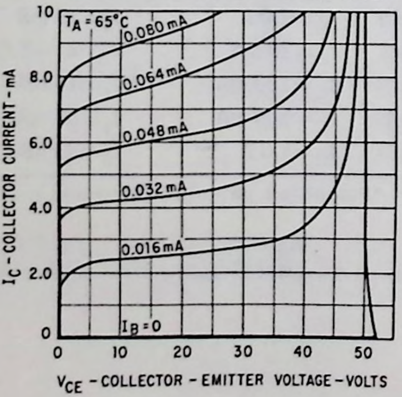
SATURATION REGION COLLECTOR CHARACTERISTICS



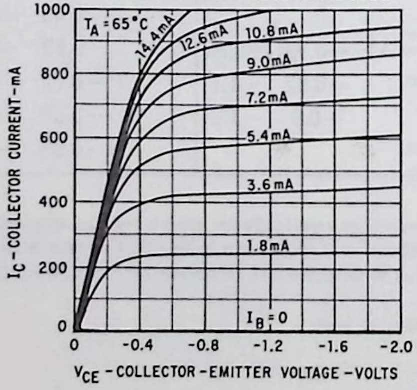
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



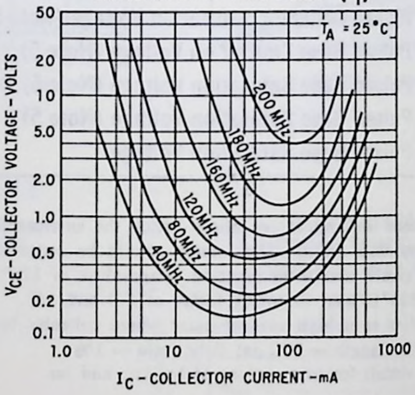
ACTIVE REGION COLLECTOR CHARACTERISTICS



SATURATION REGION COLLECTOR CHARACTERISTICS

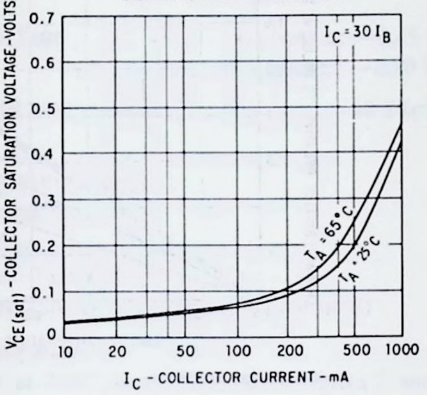


CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

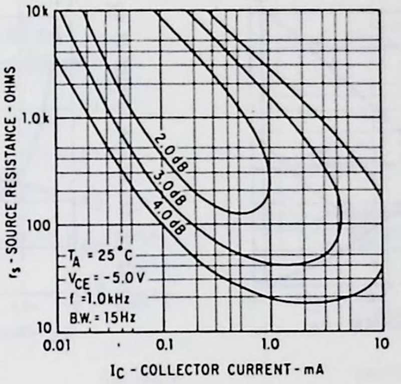


TYPICAL ELECTRICAL CHARACTERISTICS
(2N5041 only)

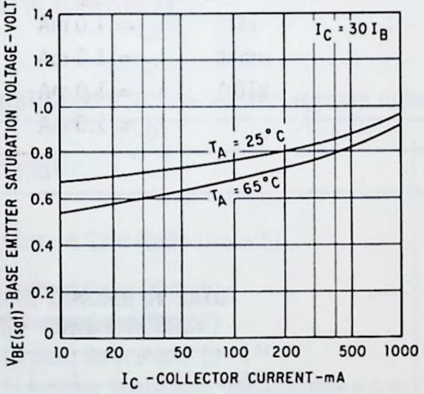
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



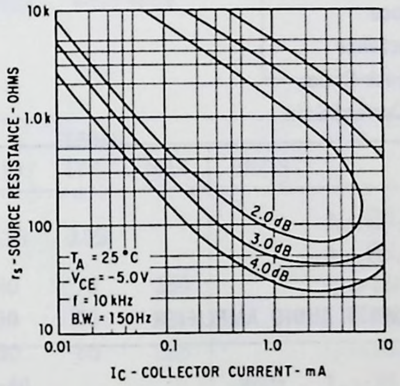
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



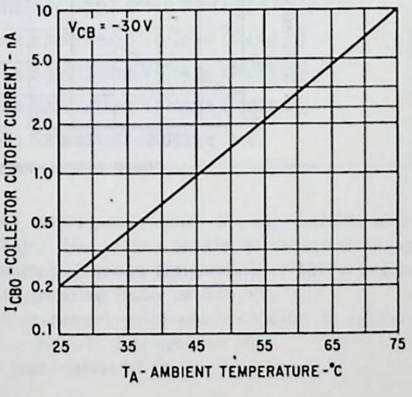
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



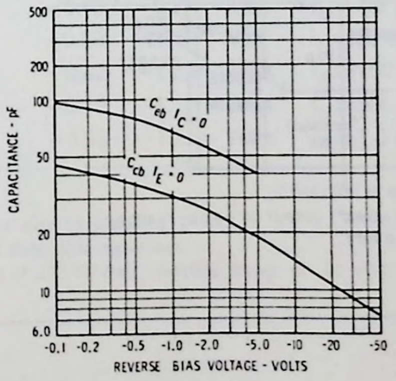
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE

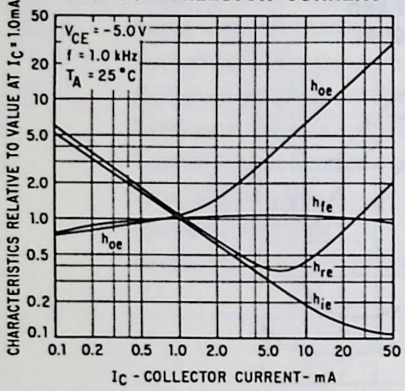


INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

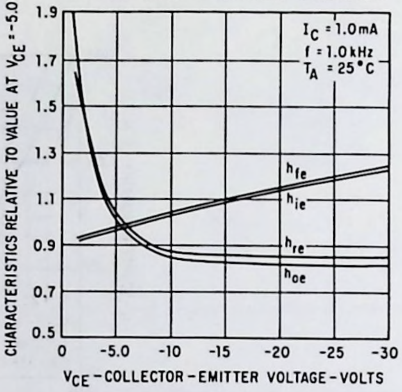


TYPICAL ELECTRICAL CHARACTERISTICS
(2N5041 only)

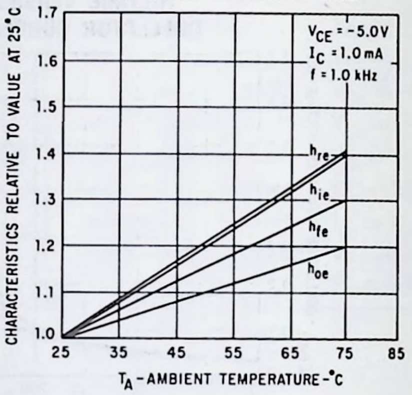
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR - EMITTER VOLTAGE



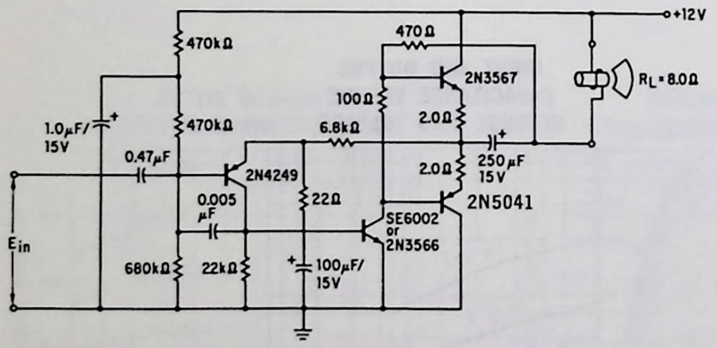
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

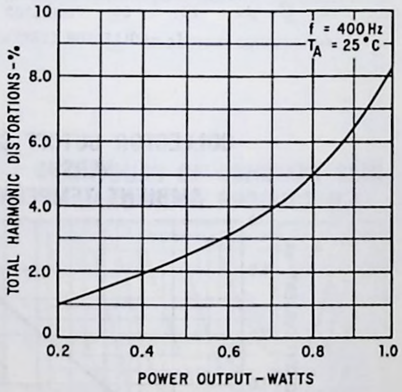
SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	2.3	kΩ	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{oe}	Output Conductance	17	µmho	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{re}	Voltage Feedback Ratio	4.5	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{fe}	Small Signal Current Gain	78		$I_C = 1.0$ mA	$V_{CE} = -5.0$ V

1.0 WATT AUDIO AMPLIFIER


+12V
470kΩ
470kΩ
1.0µF/
15V
0.47µF
2N4249
0.005
µF
680kΩ
22kΩ
22Ω
100µF/
15V
6.8kΩ
470Ω
100Ω
2N3567
2.0Ω
2.0Ω
250µF
15V
2N5041
SE6002
or
2N3566
R_L = 8.0Ω
E_{in}

SENSITIVITY—14 mV (rms) FOR 1.0 WATT OUTPUT (R_L = 8.0 Ω; f = 400 Hz)
S+N/N — 62 dB BELOW 1.0 WATT

TOTAL HARMONIC DISTORTION VERSUS POWER OUTPUT



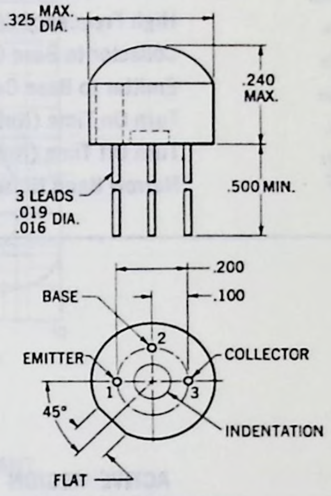
FT5040 · FT5041

PNP HIGH CURRENT AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH POWER DISSIPATION** . . . . 4.0 WATT @ $T_C = 25°C$
- **EXCELLENT BETA LINEARITY** . . . . $\frac{h_{FE} @ 500 \text{ mA}}{h_{FE} @ 150 \text{ mA}} = 0.75$ (Min.)
- **LOW SATURATION VOLTAGE** . . . . $V_{CE}(sat) = -0.45$ V (typ.) @ $I_C = 1.0$A, $I_B = 33$ mA
  . . . . $V_{CE}(sat) = -0.20$ V (typ.) @ $I_C = 500$ mA, $I_B = 50$ mA
- **HIGH BREAKDOWN VOLTAGE** . . . . $LV_{CEO} = -40$ V (min.) @ $I_C = 30$ mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	**4.0 Watt**
at 25°C Free Air Temperature (Notes 2 and 3)	0.5 Watt

Maximum Voltages

		FT5040	FT5041
V_{CBO}	Collector to Base Voltage	−25 Volts	−40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−25 Volts	−40 Volts
V_{EBO}	Emitter to Base Voltage	−4.0 Volts	−5.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	FT5040 MIN.	FT5040 TYP.	FT5040 MAX.	FT5041 MIN.	FT5041 TYP.	FT5041 MAX.	UNITS	TEST CONDITIONS	
$\frac{h_{FE2}}{h_{FE1}}$	**DC Pulse Current Gain Ratio** (Note 5)		0.5		0.75	0.85			h_{FE1}@I_C=150 mA h_{FE2}@I_C=500 mA	$V_{CE} = -1.0$ V $V_{CE} = -1.0$ V
h_{FE1}	**DC Pulse Current Gain** (Note 5)	30	170		40	75	150		I_C=150 mA	$V_{CE} = -1.0$ V
h_{FE2}	**DC Pulse Current Gain** (Note 5)	20	75		30	65			I_C=500 mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	200		30	85	225		I_C=10 mA	$V_{CE} = -1.0$ V
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Note 4 & 5)	−25			−40			Volts	I_C=30 mA (pulsed)	I_B=0
BV_{CBO}	Collector to Base Breakdown Voltage	−25			−40			Volts	I_C=100 μA	I_E=0
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			−5.0			Volts	I_C=0	I_E=10 μA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.09	−0.25		−0.09	−0.25	Volt	I_C=150 mA	I_B=15 mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		−0.4	−1.0		−0.2	−0.5	Volt	I_C=500 mA	I_B=50 mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)					−0.45	−1.3	Volts	I_C=1.0 A	I_B=33 mA
V_{BE}(on)	Pulsed Base Emitter on Voltage (Note 5)		−0.69	−0.85		−0.69	−0.75	Volt	I_C=20 mA	$V_{CE} = -5.0$ V
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.82	−1.1		−0.82	−1.1	Volts	I_C=150 mA	I_B=15 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.9	−1.2		−0.85	−1.1	Volts	I_C=500 mA	I_B=50 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage					−0.95	−1.2	Volts	I_C=1.0 A	I_B=33 mA

*Planar is a patented Fairchild process.

OTES:
) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 40 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).
) This rating refers to a high current point where collector to emitter voltage is lowest.
) Pulse conditions: length = 300 μs; duty cycle = 1%.
) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

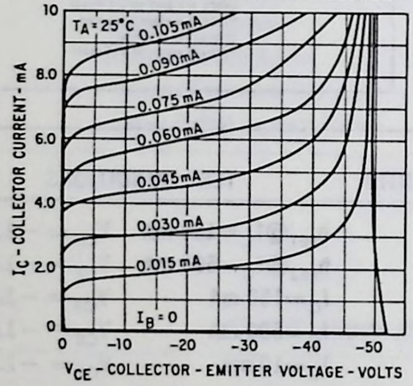
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

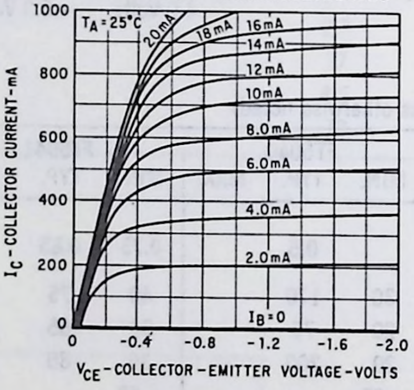
SYMBOL	CHARACTERISTIC	FT5040 MIN.	FT5040 TYP.	FT5040 MAX.	FT5041 MIN.	FT5041 TYP.	FT5041 MAX.	UNITS	TEST CONDITIONS	
I_{CBO}	Collector Cutoff Current		0.1	50				nA	$I_C = 0$	$V_{CB} = -15\,V$
I_{CBO}	Collector Cutoff Current					0.1	50	nA	$I_C = 0$	$V_{CB} = -30\,V$
I_{CBO}(65°C)	Collector Cutoff Current		0.01	1.0				μA	$I_C = 0$	$V_{CB} = -15\,V$
I_{CBO}(65°C)	Collector Cutoff Current					0.01	1.0	μA	$I_C = 0$	$V_{CB} = -30\,V$
I_{EBO}	Emitter Cutoff Current					0.01	50	nA	$I_C = 0$	$V_{EB} = -4.0\,V$
h_{fe}	High Frequency Current Gain (f = 100 MHz)	0.8	2.0		1.0	2.0			$I_C = 50\,mA$	$V_{CE} = -10\,V$
c_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		15	35		15	35	pF	$I_E = 0$	$V_{CB} = -10\,V$
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		75	120		75	120	pF	$I_C = 0$	$V_{EB} = -0.5\,V$
t_{on}	Turn On Time (Note 6)		23			30		ns	$I_C \approx 500\,mA$	$I_{B1} \approx 50\,mA$
t_{off}	Turn Off Time (Note 6)		200			250		ns	$I_C \approx 500\,mA$	$I_{B1} = I_{B2} \approx 50\,mA$
NF	Narrow Band Noise Figure (f = 1.0 kHz)		1.0			1.0		dB	$I_C = 200\,\mu A$	$V_{CE} = -5.0\,V$ $R_S = 1.0\,k\Omega$

TYPICAL ELECTRICAL CHARACTERISTICS
(FT5041 only)

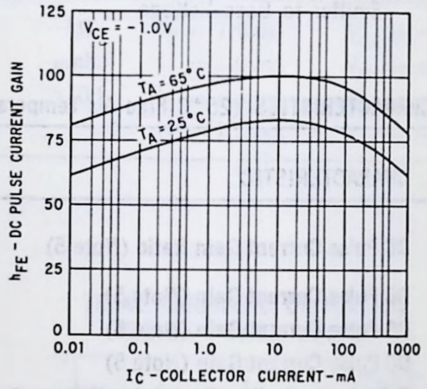
ACTIVE REGION COLLECTOR CHARACTERISTICS*



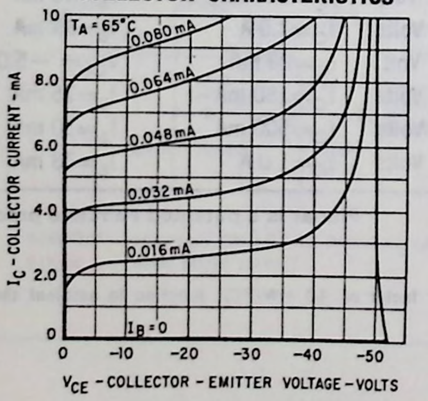
SATURATION REGION COLLECTOR CHARACTERISTICS*



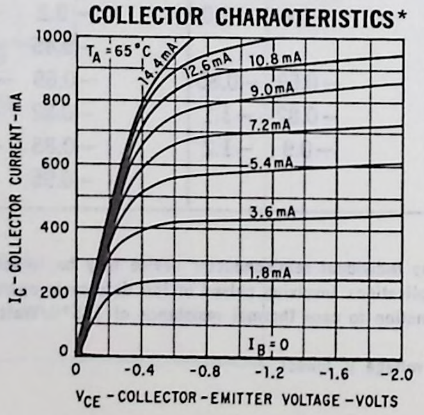
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



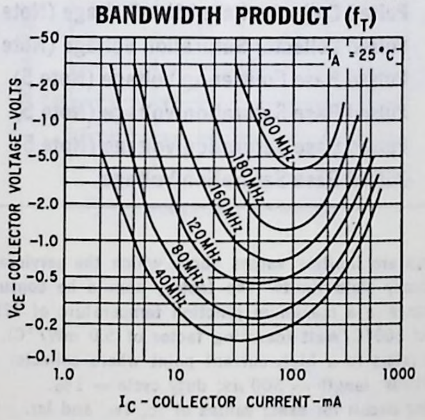
ACTIVE REGION COLLECTOR CHARACTERISTICS*



SATURATION REGION COLLECTOR CHARACTERISTICS*



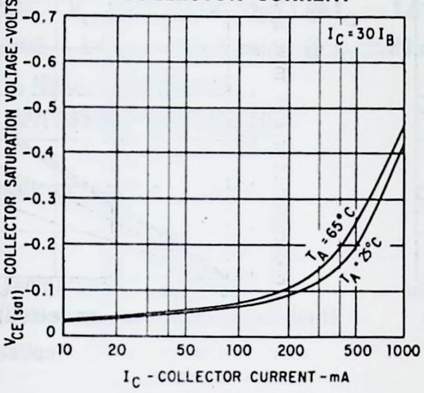
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



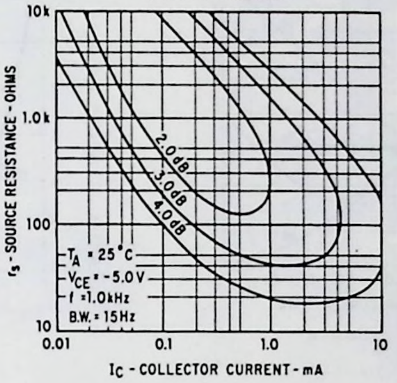
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS
(FT5041 only)

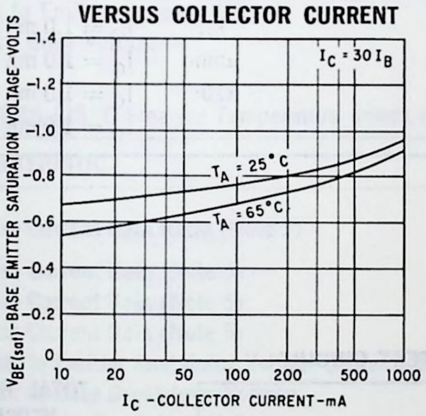
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



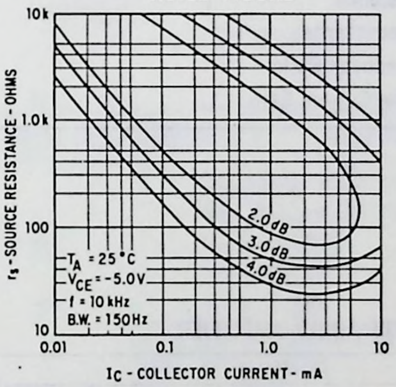
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



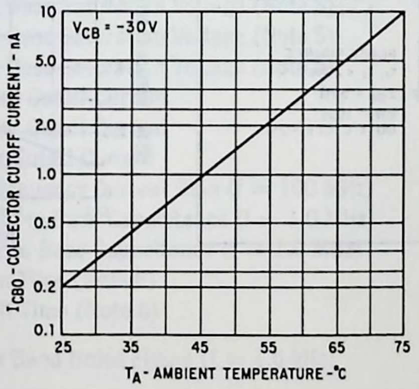
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



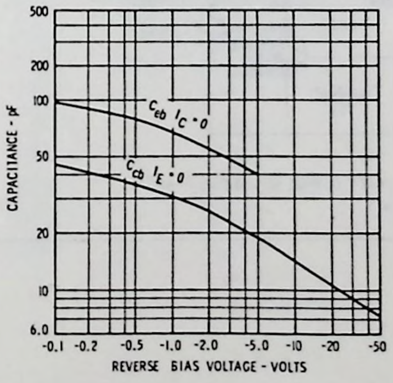
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE

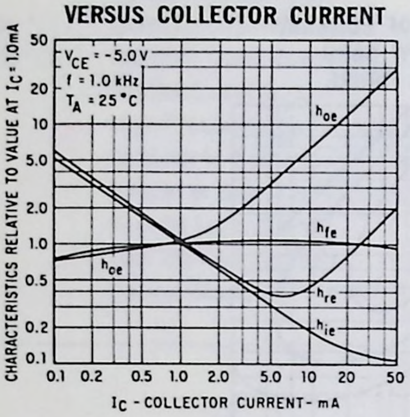


INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

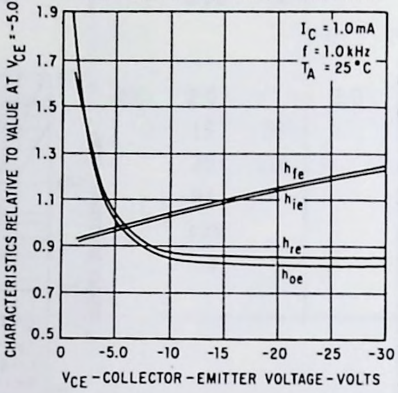


TYPICAL ELECTRICAL CHARACTERISTICS
(FT5041 only)

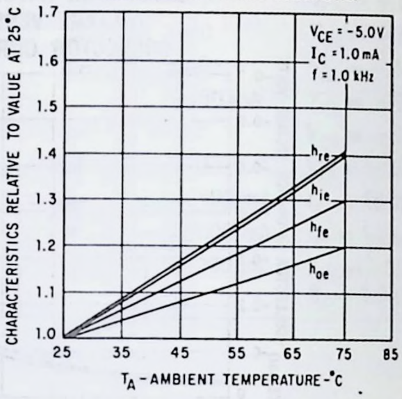
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR - EMITTER VOLTAGE



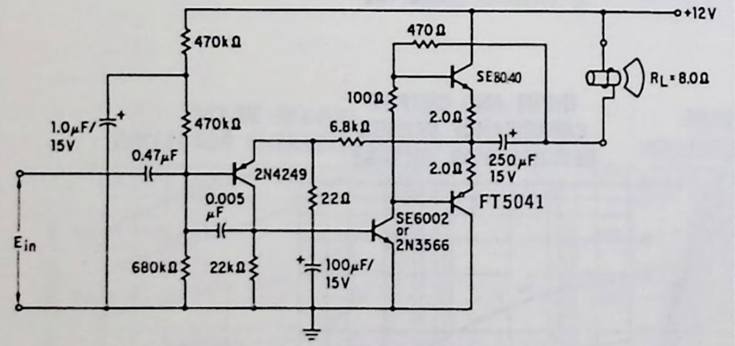
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	2.3	kΩ	$I_C = 1.0$ mA	$V_{CE} = -5.0$V
h_{oe}	Output Conductance	17	μmho	$I_C = 1.0$ mA	$V_{CE} = -5.0$V
h_{re}	Voltage Feedback Ratio	4.5	x10⁻⁴	$I_C = 1.0$ mA	$V_{CE} = -5.0$V
h_{fe}	Small Signal Current Gain	78		$I_C = 1.0$ mA	$V_{CE} = -5.0$V

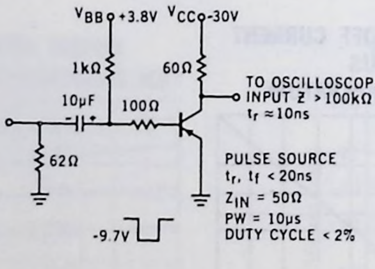
1.0 WATT AUDIO AMPLIFIER



+12V
470kΩ
470Ω
SE8040
R_L = 8.0Ω
100Ω
2.0Ω
1.0μF/ 15V
470kΩ
6.8kΩ
0.47μF
2N4249
2.0Ω
250μF 15V
0.005 μF
22Ω
FT5041
SE6002 or 2N3566
E_{in}
680kΩ
22kΩ
100μF/ 15V

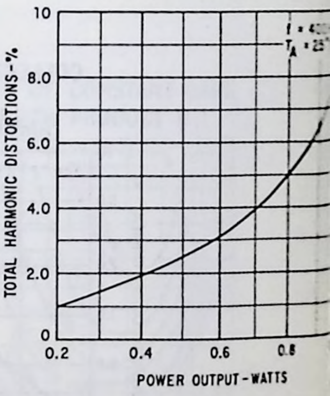
SENSITIVITY—14 mV (rms) FOR 1.0 WATT OUTPUT (R_L = 8.0Ω; f = 400 Hz)
S+N/N — 62dB BELOW 1.0 WATT

t_{on} AND t_{off} TEST CIRCUIT



V_{BB} +3.8V
V_{CC} -30V
1kΩ
60Ω
TO OSCILLOSCOPE INPUT Z > 100kΩ
t_r ≈ 10ns
10μF
100Ω
62Ω
PULSE SOURCE
t_r, t_f < 20ns
Z_{IN} = 50Ω
PW = 10μs
DUTY CYCLE < 2%
-9.7V

TOTAL HARMONIC DISTORTI
VERSUS POWER OUTPUT



2N5042

PNP HIGH CURRENT AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

XCELLENT BETA LINEARITY - - $\frac{h_{FE} @ 500\ mA}{h_{FE} @ 150\ mA} = 0.75$ **(min.)**

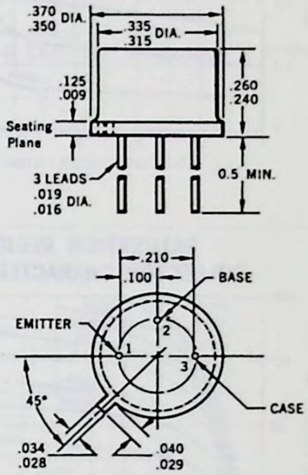
OW SATURATION VOLTAGE - - V_{CE}**(sat) = 0.45 (typ.) @** $I_C = 1.0$ **A,** $I_B = 33$ **mA**

IGH BREAKDOWN VOLTAGE - - $LV_{CEO} = 40$ **V (min.) @** $I_C = 30$ **mA**

OW DISTORTION - - 0.5% (typ.) @ 5.0 WATTS

OMPLEMENTARY WITH NPN SE8002 AND 2N3110

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold-plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

OLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation

Total Dissipation

at 25°C Case Temperature (Notes 2 & 3)	4.0 Watts
at 25°C Ambient Temperature (Notes 2 & 3)	0.8 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	−40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE2} h_{FE1}	**DC Pulse Current Gain Ratio** (Note 5)	**0.75**	**0.85**			h_{FE1} @ $I_C = 150$ mA h_{FE2} @ $I_C = 500$ mA	$V_{CE} = -1.0$ V $V_{CE} = -1.0$ V
h_{FE1}	**DC Pulse Current Gain** (Note 5)	**40**	**75**	**150**		$I_C = 150$ mA	$V_{CE} = -1.0$ V
h_{FE2}	**DC Pulse Current Gain** (Note 5)	**30**	**65**			$I_C = 500$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	85	225		$I_C = 10$ mA	$V_{CE} = -1.0$ V
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 & 5)	**−40**			**Volts**	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−40			Volts	$I_C = 100\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.09	−0.25	Volt	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		−0.20	−0.50	Volt	$I_C = 500$ mA	$I_B = 50$ mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		**−0.45**	**−1.3**	**Volts**	$I_C = 1.0$ A	$I_B = 33$ mA
V_{BE}(on)	Pulsed Base Emitter On Voltage (Note 5)		−0.69	−0.75	Volt	$I_C = 20$ mA	$V_{CE} = -5.0$V
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.82	−1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.85	−1.1	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.95	−1.2	Volts	$I_C = 1.0$ A	$I_B = 33$ mA
$_{CBO}$	Collector Cutoff Current		0.2	50	nA	$I_E = 0$	$V_{CB} = -30$ V
$_{CBO}$(150°C)	Collector Cutoff Current		1.0	20	μA	$I_E = 0$	$V_{CB} = -30$ V
$_{EBO}$	Emitter Cutoff Current		0.1	50	nA	$I_C = 0$	$V_{EB} = -4.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.0	2.0	5.0		$I_C = 50$ mA	$V_{CE} = -10$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		15	35	pF	$I_E = 0$	$V_{CB} = -10$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		75	120	pF	$I_C = 0$	$V_{EB} = -0.5$ V
t_{on}	Turn On Time (Note 6)		23		ns	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA
t_{off}	Turn Off Time (Note 6)		200		ns	$I_C \approx 500$ mA	$I_{B1} = I_{B2} \approx 50$ mA
NF	Narrow Band Noise Figure (f = 1.0 kHz)		1.0		dB	$I_C = 200\ \mu A$	$V_{CE} = 5.0$ V $R_S = 1.0\ k\Omega$

*Planar is a patented Fairchild process.

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD
SEMICONDUCTOR
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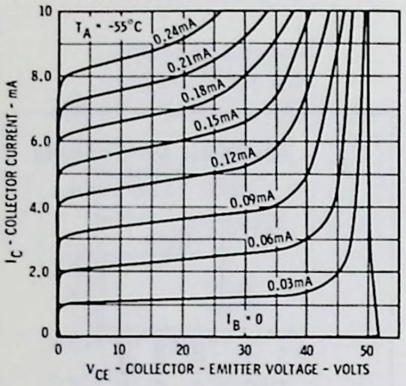
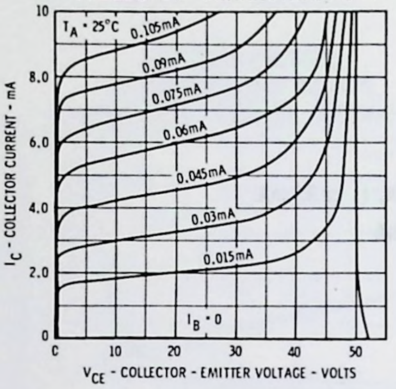
FAIRCHILD TRANSISTOR 2N5042

TYPICAL ELECTRICAL CHARACTERISTICS

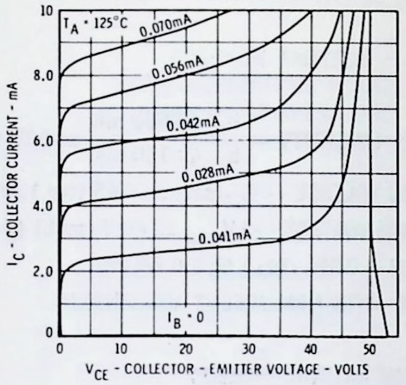
ACTIVE REGION COLLECTOR CHARACTERISTICS



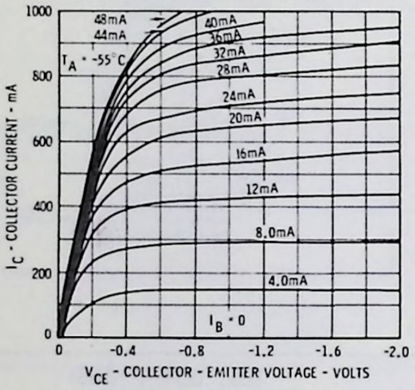
ACTIVE REGION COLLECTOR CHARACTERISTICS



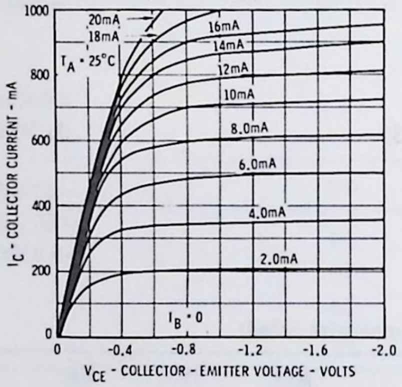
ACTIVE REGION COLLECTOR CHARACTERISTICS



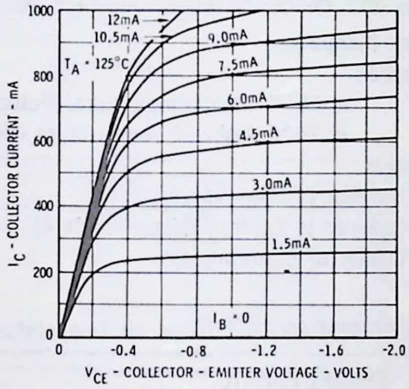
SATURATION REGION COLLECTOR CHARACTERISTICS



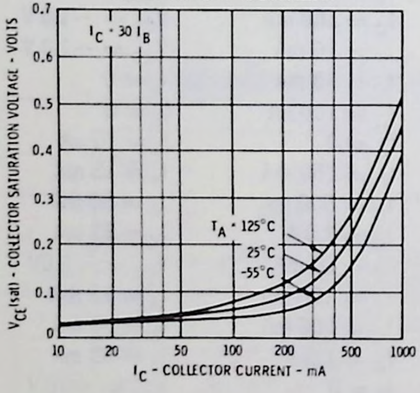
SATURATION REGION COLLECTOR CHARACTERISTICS



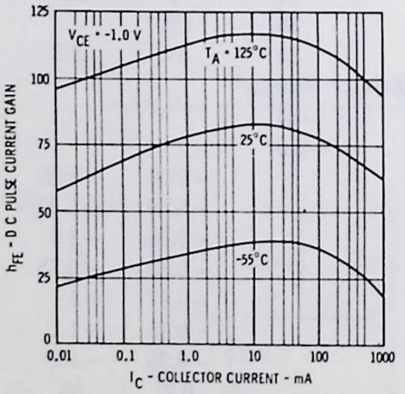
SATURATION REGION COLLECTOR CHARACTERISTICS



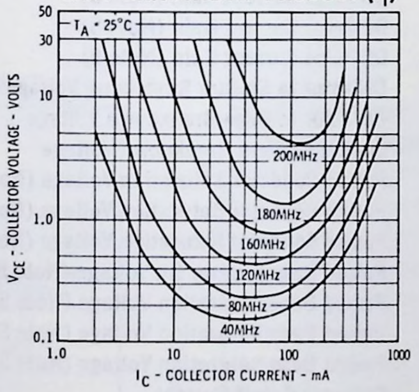
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



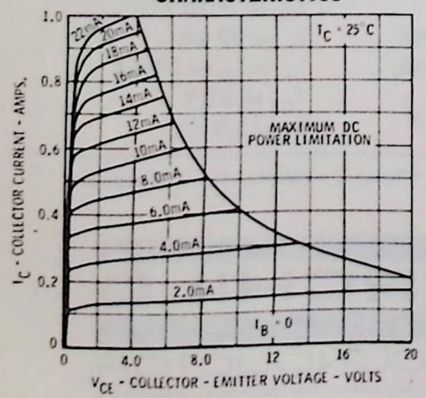
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



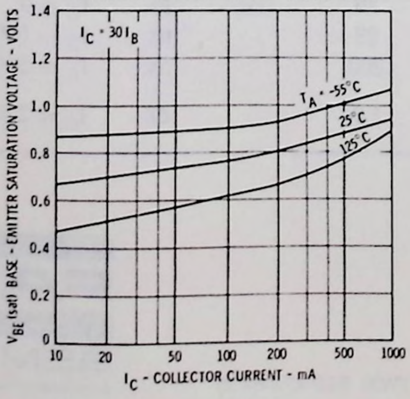
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



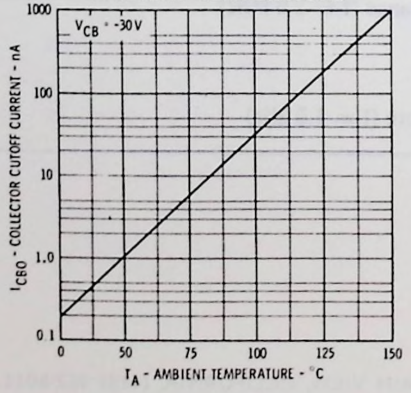
LARGE SIGNAL COLLECTOR CHARACTERISTICS



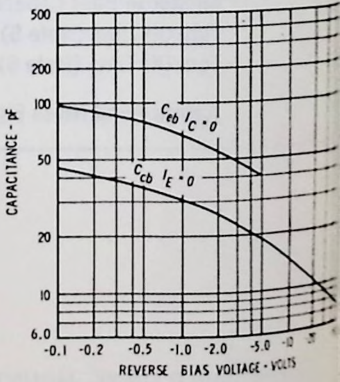
PULSED BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



FAIRCHILD TRANSISTOR 2N5042

SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	2.3	kΩ	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance	17	μmhos	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{re}	Voltage Feedback Ratio	4.5	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{fe}	Small Signal Current Gain	78		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

NOTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.8°C/Watt (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

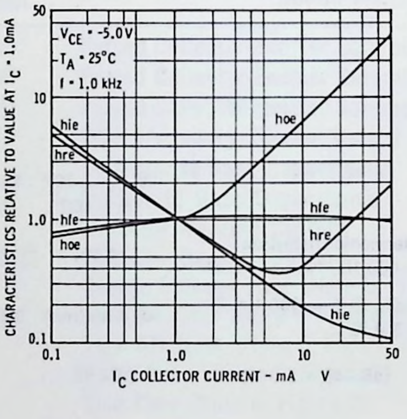
4) This rating refers to a high current point where collector-to-emitter voltage is lowest.

5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

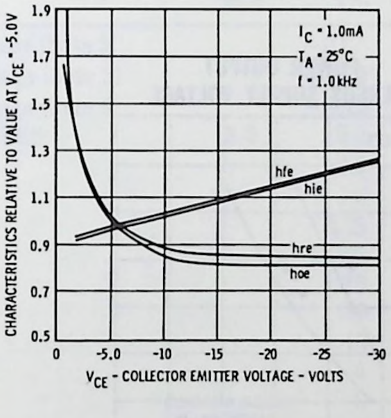
6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

TYPICAL ELECTRICAL CHARACTERISTICS

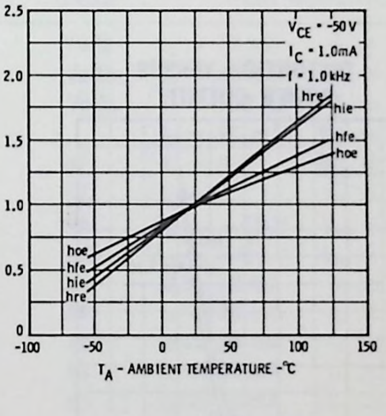
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



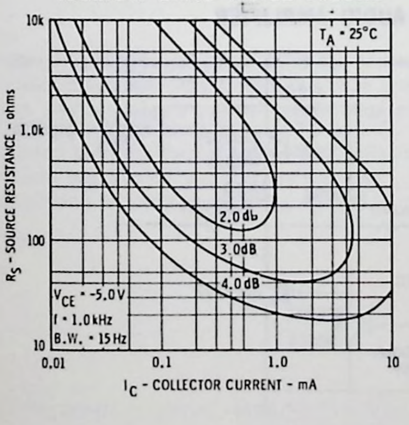
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



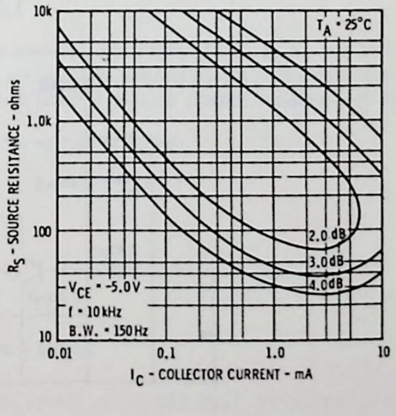
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



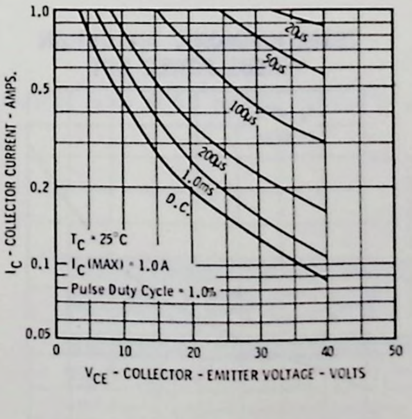
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



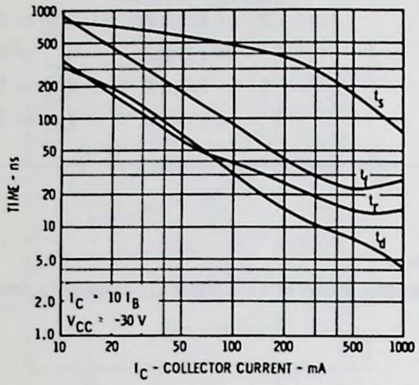
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



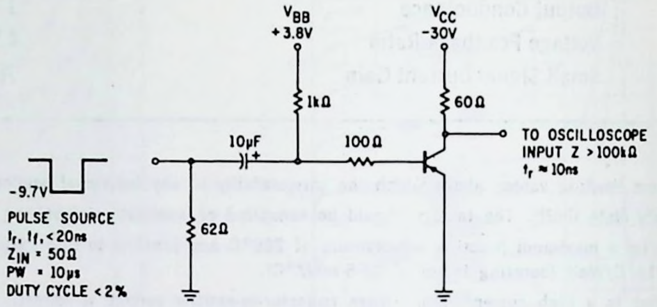
FORWARD BIASED SAFE OPERATING AREA



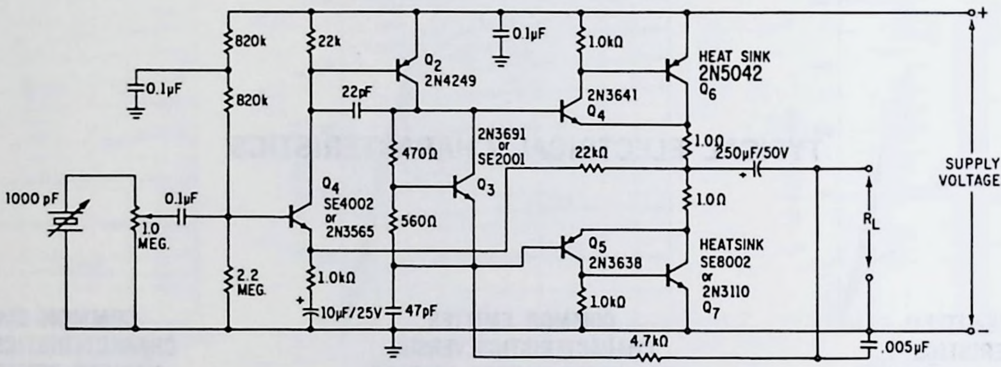
SWITCHING TIMES VERSUS COLLECTOR CURRENT



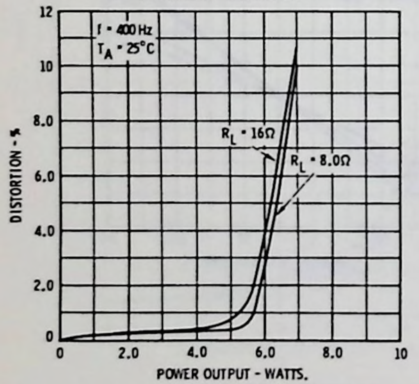
t_{on} AND t_{off} TEST CIRCUIT


V_{BB}
+3.8V
V_{CC}
-30V
1kΩ
60Ω
10μF
100Ω
TO OSCILLOSCOPE
INPUT Z > 100kΩ
t_r ≈ 10ns
-9.7V
PULSE SOURCE
t_r, t_f, < 20ns
Z_{IN} = 50Ω
PW = 10μs
DUTY CYCLE < 2%
62Ω

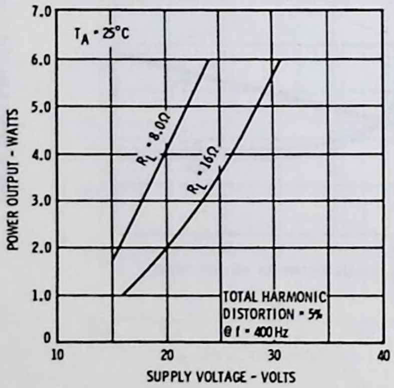
FIVE WATT AUDIO AMPLIFIER


820k
22k
Q_2
2N4249
0.1μF
1.0kΩ
HEAT SINK
2N5042
Q_6
0.1μF
820k
22pF
2N3641
Q_4
2N3691
or
SE2001
470Ω
Q_3
22kΩ
1.0Ω
250μF/50V
SUPPLY
VOLTAGES
1000 pF
0.1μF
1.0
MEG.
Q_4
SE4002
or
2N3565
560Ω
1.0Ω
R_L
Q_5
2N3638
HEATSINK
SE8002
or
2N3110
Q_7
2.2
MEG.
1.0kΩ
1.0kΩ
10μF/25V
47pF
4.7kΩ
.005μF
+

DISTORTION VERSUS POWER OUTPUT

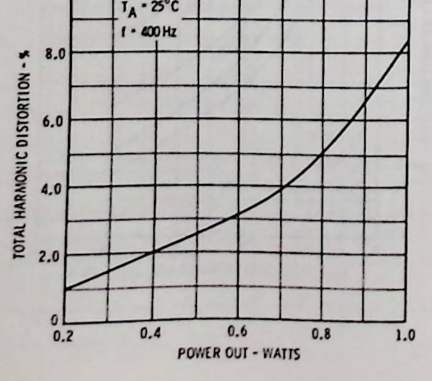


POWER OUTPUT VERSUS SUPPLY VOLTAGE

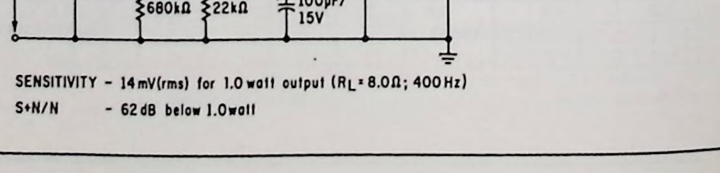


	V_{supply}=30V R_L=16Ω	V_{supply}=24V R_L=8.0 Ω
Total Harmonic Distortion @ f = 400 Hz, P_{out} = 5.0 W	0.7%	0.5%
Sensitivity @ f = 400 Hz, P_{out} = 5.0 W	410 mV(rms)	300 mV(rms)
$\frac{S+N}{N}$ (dB below 5.0 W)	64 dB	75 dB

TOTAL HARMONIC DISTORTION VERSUS POWER OUT



1.0 WATT AUDIO AMPLIFIER


+12V
470kΩ
470Ω
SE8002
or
2N3110
R_L = 8.0Ω
1.0μF/
15V
470kΩ
100Ω
2.0Ω
6.8kΩ
250μF/15V
0.47μF
2.0Ω
2N4249
22Ω
2N5042
0.005pF
SE6002
or
2N3566
E_{in}
680kΩ
22kΩ
100μF/
15V

SENSITIVITY - 14mV(rms) for 1.0 watt output (R_L = 8.0Ω; 400 Hz)

S+N/N - 62 dB below 1.0 watt

2N5055

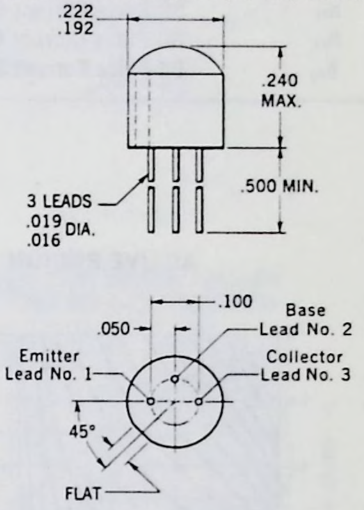
PNP HIGH-SPEED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

FAST SWITCHING . . . . t_{on} = 20 ns (MAX) @ 30 mA
. . . . t_{off} = 25 ns (MAX) @ 30 mA
. . . . τ_s = 20 ns (MAX) @ 10 mA
HIGH FREQUENCY . . . . f_T = 550 MHz (MIN) @ 20 mA
LOW CAPACITANCE . . . . C_{cb} = 4.5 pF (MAX) @ 5 V
LOW SATURATION VOLTAGE . . . $V_{CE\,(sat)}$ = 0.19 V (MAX) @ 30 mA

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 seconds time limit)	+260°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	0.5 Watt
at 25°C Ambient Temperature [Notes 2 and 3]	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	−12 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	−12 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts
V_{CES}	Collector to Emitter Voltage	−12 Volts
I_C	Collector Current [Note 2]	100 mA

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	Typ.	MAX.	UNITS	TEST CONDITIONS	
V_{CE} (sat)	Pulsed Collector-Emitter Saturation Voltage [Note 5]		−0.07	−0.13	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE} (sat)	**Pulsed Collector-Emitter Saturation Voltage [Note 5]**		**−0.10**	**−0.19**	**Volts**	**I_C = 30 mA**	**I_B = 3.0 mA**
V_{CE} (sat)	**Pulsed Collector-Emitter Saturation Voltage [Note 5]**		**−0.25**	**−0.45**	**Volts**	**I_C = 100 mA**	**I_B = 10 mA**
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**5.5**	**9.0**			**I_C = 20 mA**	**V_{CE} = −10 V**
C_{cb}	**Collector to Base Capacitance**		**3.3**	**4.5**	**pF**	**I_E = 0**	**V_{CB} = −5.0 V**
C_{eb}	Emitter to Base Capacitance		3.8	6.0	pF	I_C = 0	V_{EB} = −0.5 V
I_{CES}	Collector Reverse Current		0.05	50	nA	V_{CE} = −10 V	V_{EB} = 0
I_{CES} (65°C)	Collector Reverse Current		0.002	10	μA	V_{CE} = −10 V	V_{EB} = 0
τ_s	**Charge Storage Time** [Note 6, Figure 1]		**15**	**20**	**ns**	**$I_C \approx$ 10 mA**	**$I_{B1} \approx I_{B2} \approx$ 10 mA**
t_{on}	**Turn On Time** [Note 6, Figure 2]		**10**	**20**	**ns**	**$I_C \approx$ 30 mA**	**$I_{B1} \approx$ 3.0 mA**
t_{off}	**Turn Off Time** [Note 6, Figure 2]		**15**	**25**	**ns**	**$I_C \approx$ 30 mA**	**$I_{B1} \approx I_{B2} \approx$ 3.0 mA**
t_d	Delay Time [Note 6, Figure 2]		4	10	ns	$I_C \approx$ 30 mA	$I_{B1} \approx$ 3.0 mA
t_r	Rise Time [Note 6, Figure 2]		6	15	ns	$I_C \approx$ 30 mA	$I_{B1} \approx$ 3.0 mA
t_s	Storage Time [Note 6, Figure 2]		12	20	ns	$I_C \approx$ 30 mA	$I_{B1} \approx I_{B2} \approx$ 3.0 mA
t_f	Fall Time [Note 6, Figure 2]		3	15	ns	$I_C \approx$ 30 mA	$I_{B1} \approx I_{B2} \approx$ 3.0 mA

* Planar is a patented Fairchild process.

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
This rating refers to a high-current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.
See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

FAIRCHILD
SEMICONDUCTOR
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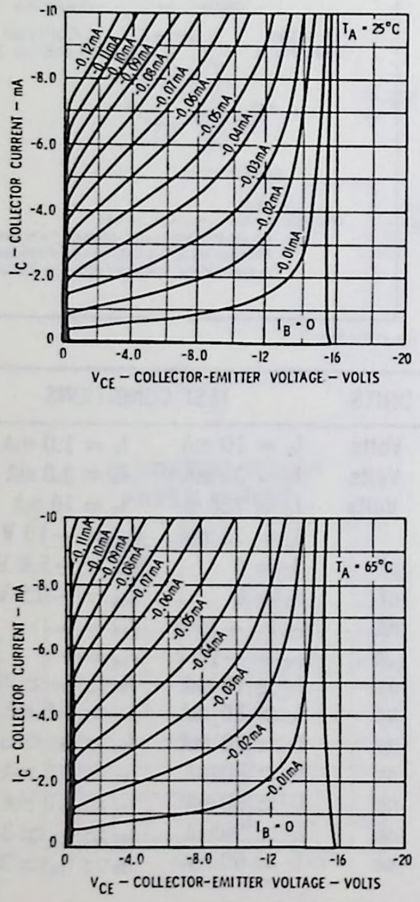
FAIRCHILD TRANSISTOR 2N5055

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Noted)

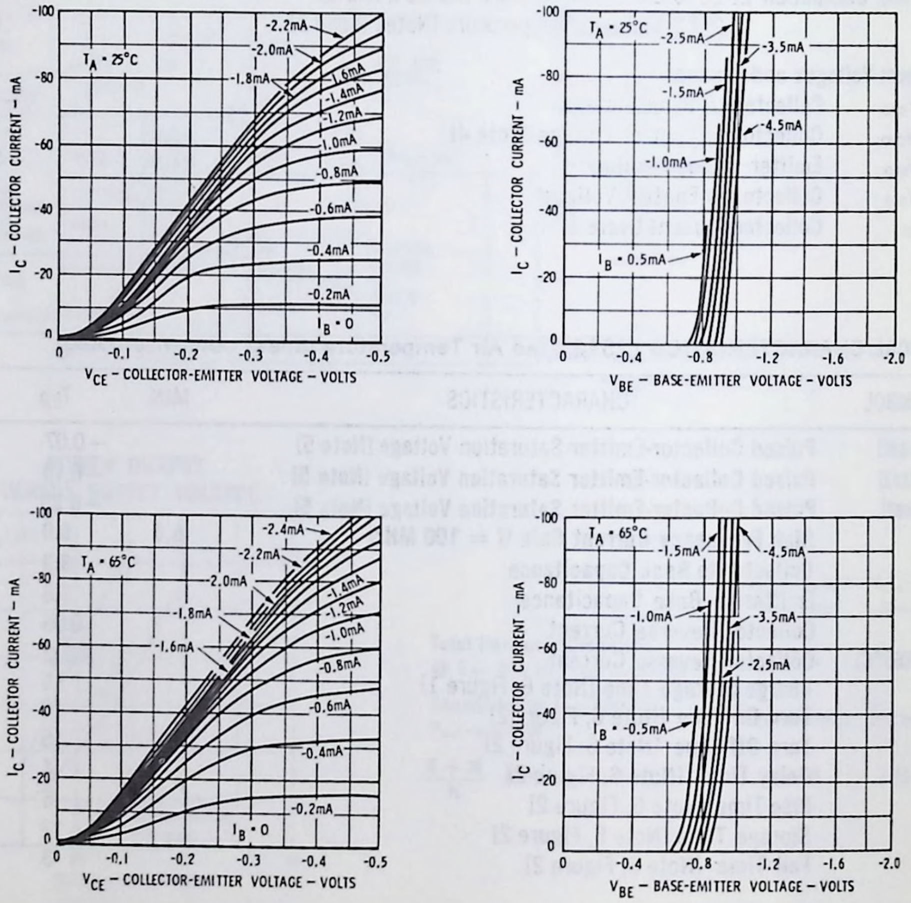
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage		−0.88	−0.92	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage	−0.8	−0.93	−1.15	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Pulsed Base-Emitter Saturation Voltage	−0.95	−1.14	−1.5	Volts	I_C = 100 mA	I_B = 10 mA
$V_{CEO\,(sus)}$	**Collector-Emitter Sustaining Voltage** [Notes 4 and 5]	**−12**			**Volts**	**I_C = 10 mA** (pulsed)	**I_B = 0**
BV_{CBO}	Collector-Base Breakdown Voltage	−12			Volts	I_C = 100 μA	I_E = 0
BV_{EBO}	Emitter-Base Breakdown Voltage	−4.5			Volts	I_E = 100 μA	I_C = 0
h_{FE}	DC Current Gain	12	44			I_C = 1.0 mA	V_{CE} = −0.5 V
h_{FE}	DC Pulse Current Gain [Note 5]	20	55			I_C = 10 mA	V_{CE} = −1.0 V
h_{FE}	DC Pulse Current Gain [Note 5]	30	63	100		I_C = 30 mA	V_{CE} = −0.5 V
h_{FE}	**DC Pulse Current Gain** [Note 5]	**20**	**55**			**I_C = 100 mA**	**V_{CE} = −1.0 V**

TYPICAL ELECTRICAL CHARACTERISTICS

ACTIVE REGION*

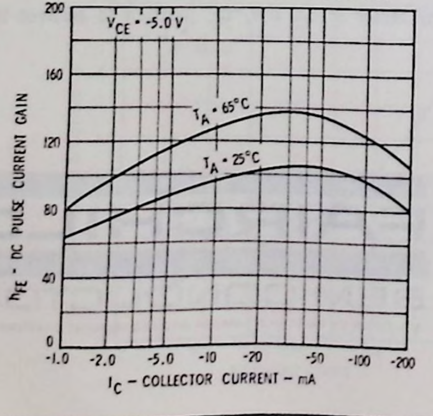


SATURATION REGION*

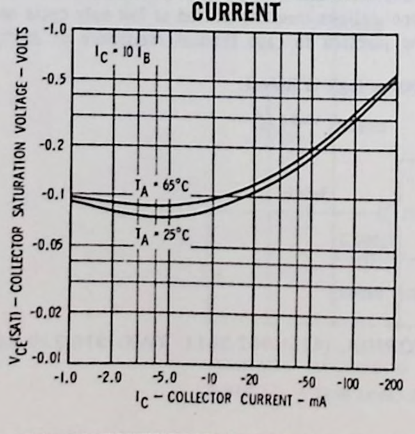


* Single family characteristic on Transistor Curve Tracer.

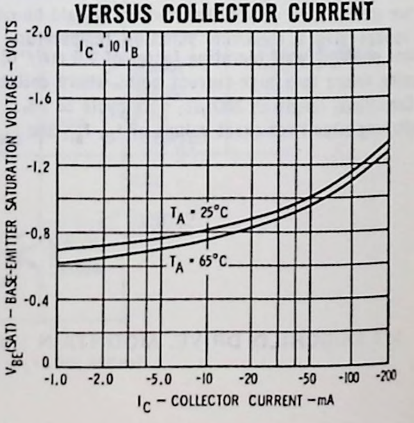
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

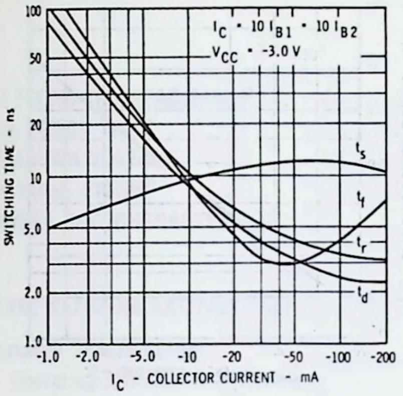


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

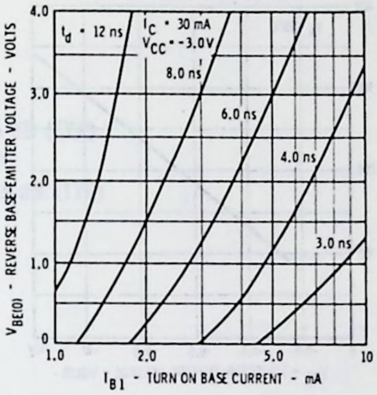


TYPICAL ELECTRICAL CHARACTERISTICS

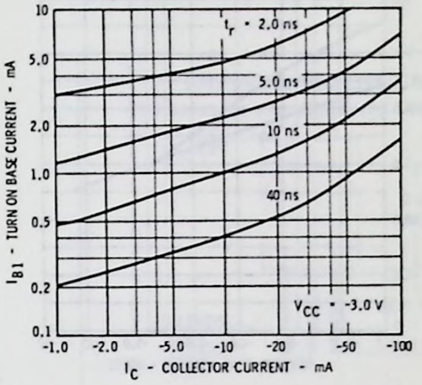
SWITCHING TIME VERSUS COLLECTOR CURRENT



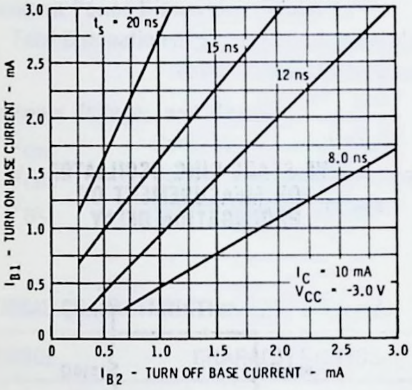
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



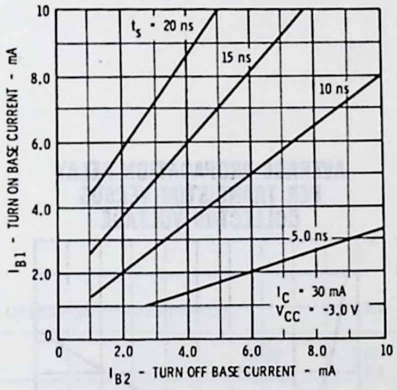
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



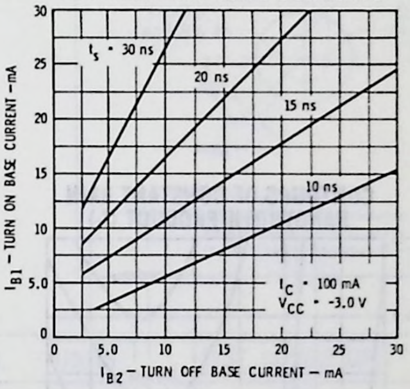
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



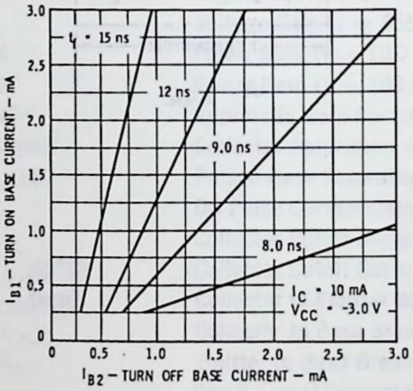
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



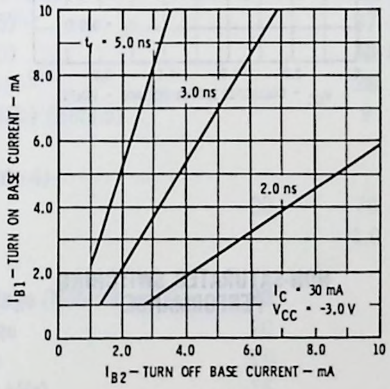
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



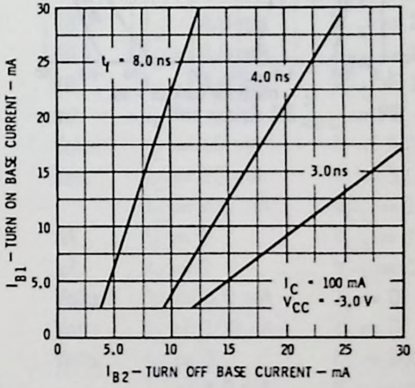
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



SWITCHING TIME VERSUS AMBIENT TEMPERATURE

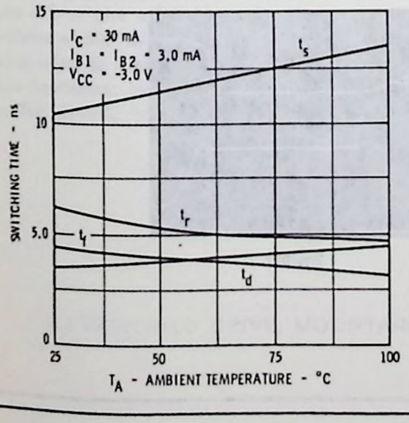


FIG. 1

CHARGE STORAGE TIME TEST CIRCUIT

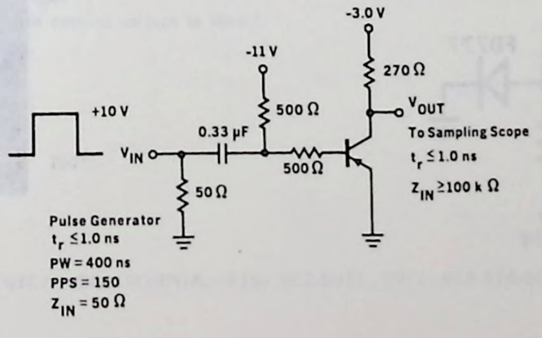
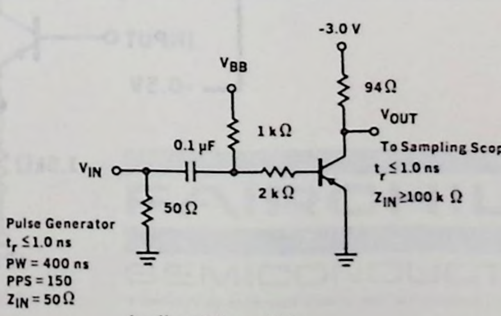

+10 V
V_{IN}
50 Ω
-11 V
0.33 µF
500 Ω
500 Ω
-3.0 V
270 Ω
V_{OUT}
To Sampling Scope
t_r ≤1.0 ns
Z_{IN} ≥100 k Ω
Pulse Generator
t_r ≤1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω

FIG. 2

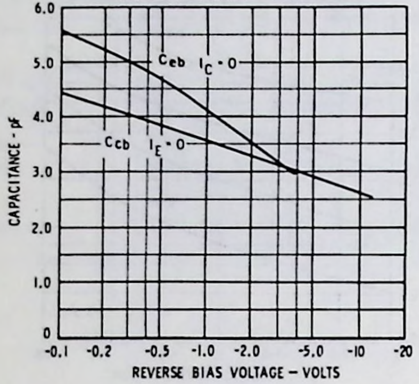
SWITCHING TIME TEST CIRCUIT


-3.0 V
V_{BB}
94 Ω
V_{OUT}
To Sampling Scope
t_r ≤1.0 ns
Z_{IN} ≥100 k Ω
0.1 µF
1 kΩ
V_{IN}
2 kΩ
50 Ω
Pulse Generator
t_r ≤1.0 ns
PW = 400 ns
PPS = 150
Z_{IN} = 50 Ω

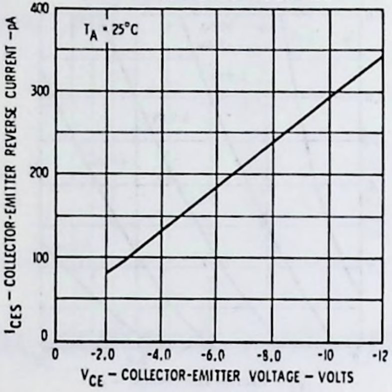
t_{on} $V_{BB} = 0$, $V_{IN} = -6.8$ V

t_{off} $V_{BB} = -9.8$ V , $V_{IN} = +11.65$ V

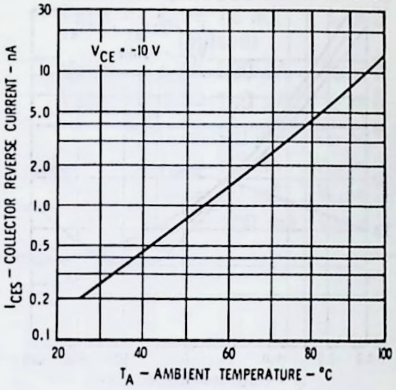
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



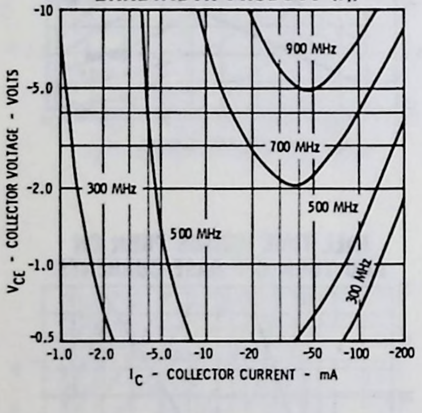
COLLECTOR-EMITTER REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



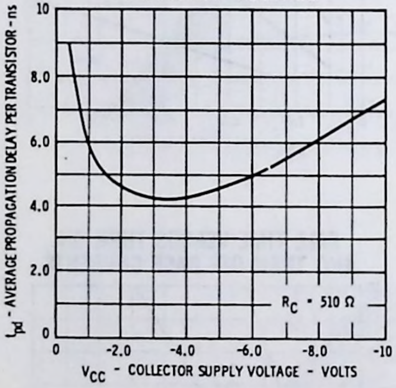
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



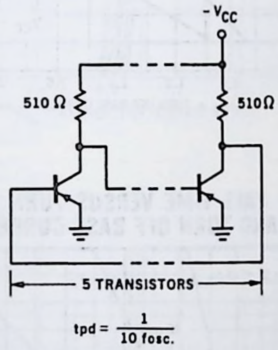
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

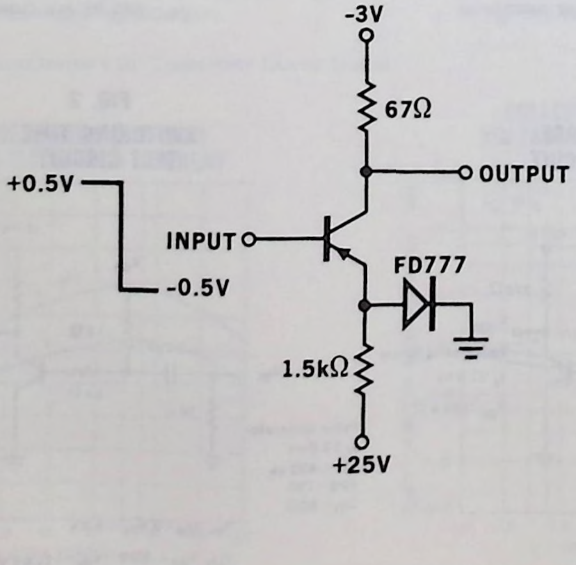


FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

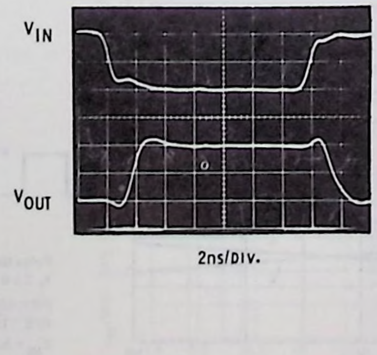

- V_{CC}
510 Ω
510Ω
5 TRANSISTORS

$$tpd = \frac{1}{10\ fosc.}$$

NON-SATURATED SWITCHING PERFORMANCE


-3V
67Ω
OUTPUT
+0.5V
INPUT
-0.5V
FD777
1.5kΩ
+25V

t_{on} = 2 ns Typ.
t_{off} = 2 ns Typ.



2ns/DIV.

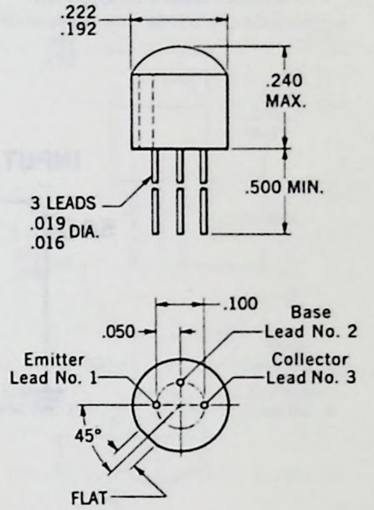
2N5126

NPN RF AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

LOW FEEDBACK CAPACITANCE . . . $C_{cb} = 1.6$ pF (MAX)
HIGH POWER GAIN . . . . PG AT 100 MHz = 26 dB (TYP)
BREAKDOWN VOLTAGE . . . . $LV_{CEO} = 20$ V (MIN)
LOW NOISE FIGURE . . . . NF AT 100 MHz = 5.5 dB (TYP)
FORWARD AGC CHARACTERISTIC

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

BSOLUTE MAXIMUM RATINGS (Notes 1 and 2)

Maximum Temperatures

Operating Junction Temperature	+125°C
Storage Temperature	−55°C to +125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Note 2)

Total Dissipation at 25°C Case Temperature	0.5 Watt
at 25°C Ambient Temperature	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	20 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
C_{cb}	**Collector-Base Capacitance**		1.1	1.6	pF	$I_E = 0$	$V_{CB} = 10$ V
NF	**Noise Figure** (Note 5)		5.5		dB	$I_C = 4.0$ mA f = 100 MHz	$V_{CC} = 15$ V $R_S = 100\Omega$
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	6.0			$I_C = 4.0$ mA	$V_{CE} = 10$ V
A_V	**Voltage Gain (f = 455 kHz)** (Note 5)		37		dB	$I_C = 4.0$ mA	$V_{CC} = 12$ V
PG	**Power Gain (f = 10.7 MHz)** (Note 5)		30		dB	$I_C = 4.0$ mA	$V_{CC} = 12$ V
PG	**Power Gain (f = 100 MHz)** (Note 5)		26		dB	$I_C = 4.0$ mA	$V_{CC} = 15$ V
AGC	**Automatic Gain Control (f = 100 MHz)** (Note 5)		9		mA	I_C for which $PG_{AGC} = PG - 30$ dB	
V_{CE}(sat)	Collector Saturation Voltage			2.0	Volts	$I_C = 10$ mA	$I_B = 5.0$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 4)			0.98	Volt	$I_C = 10$ mA	$I_B = 5.0$ mA
h_{FE}	DC Pulse Current Gain (Note 4)	20	70	350		$I_C = 4.0$ mA	$V_{CE} = 10$ V
I_{CBO}	Collector Cutoff Current		1.0	50	nA	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}(65°C)	Collector Cutoff Current			5.0	μA	$I_E = 0$	$V_{CB} = 10$ V
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 3 and 4)	**20**			**Volts**	**$I_C = 3.0$ mA**	**$I_B = 0$**
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	$I_C = 100$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	$I_C = 0$	$I_E = 100$ μA
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	15		400		$I_C = 4.0$ mA	$V_{CE} = 10$ V
V_{BE}(on)	Base to Emitter On Voltage (Note 5)			0.98	Volts	$I_C = 10$ mA	$V_{CE} = 10$ V

*Planar is a patented Fairchild process.

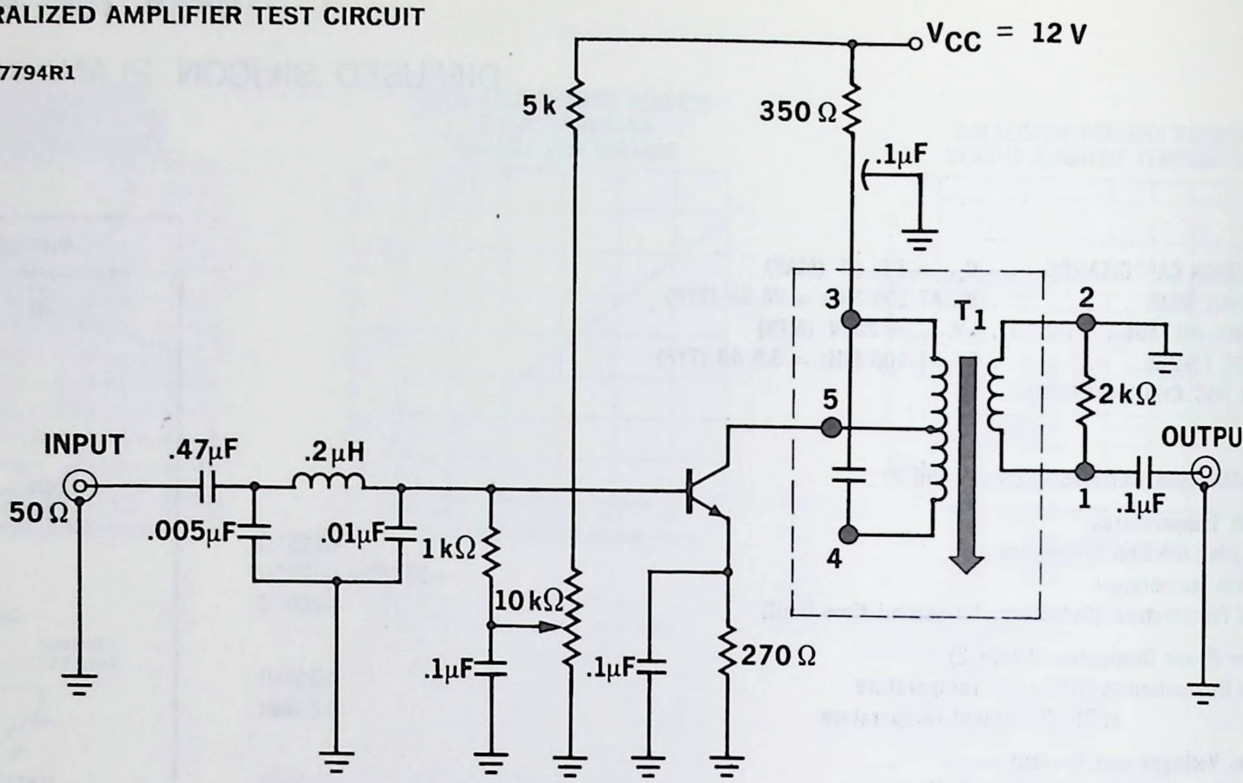
OTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
3) Rating refers to a high-current point where collector to emitter voltage is lowest.
4) Pulse Conditions: length = 300 μs; duty cycle = 1%.
5) See Test Circuit.

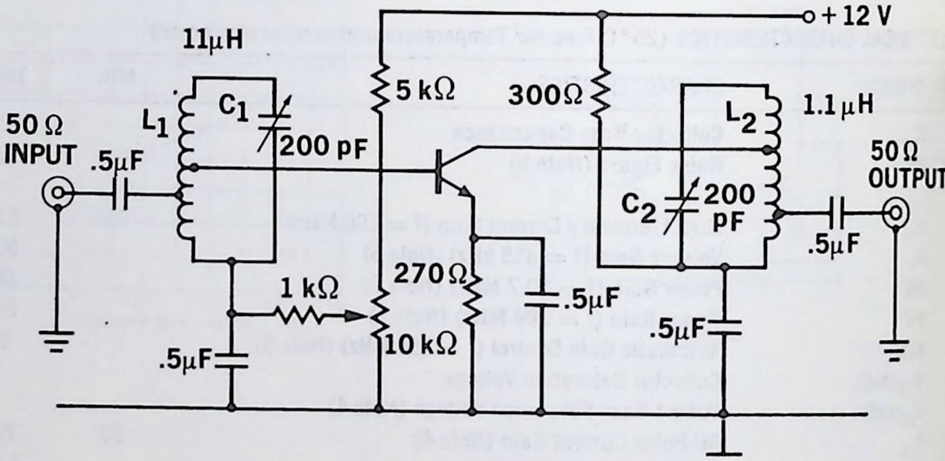
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

455 kHz UNNEUTRALIZED AMPLIFIER TEST CIRCUIT

T_1 = T.R.W. #17794R1


V_{CC} = 12 V
5 k
350 Ω
.1µF
3
2
T_1
5
2 kΩ
OUTPUT
INPUT
.47µF
.2µH
50 Ω
.005µF
.01µF
1 kΩ
1
.1µF
4
10 kΩ
.1µF
.1µF
270 Ω

10.7 MHz UNNEUTRALIZED AMPLIFIER TEST CIRCUIT


+12 V
11µH
5 kΩ
300Ω
L_1
C_1
200 pF
L_2
1.1µH
50 Ω INPUT
.5µF
50 Ω OUTPUT
C_2
200 pF
.5µF
270Ω
1 kΩ
.5µF
.5µF
10 kΩ
.5µF

C_1 and C_2 ARCO #465

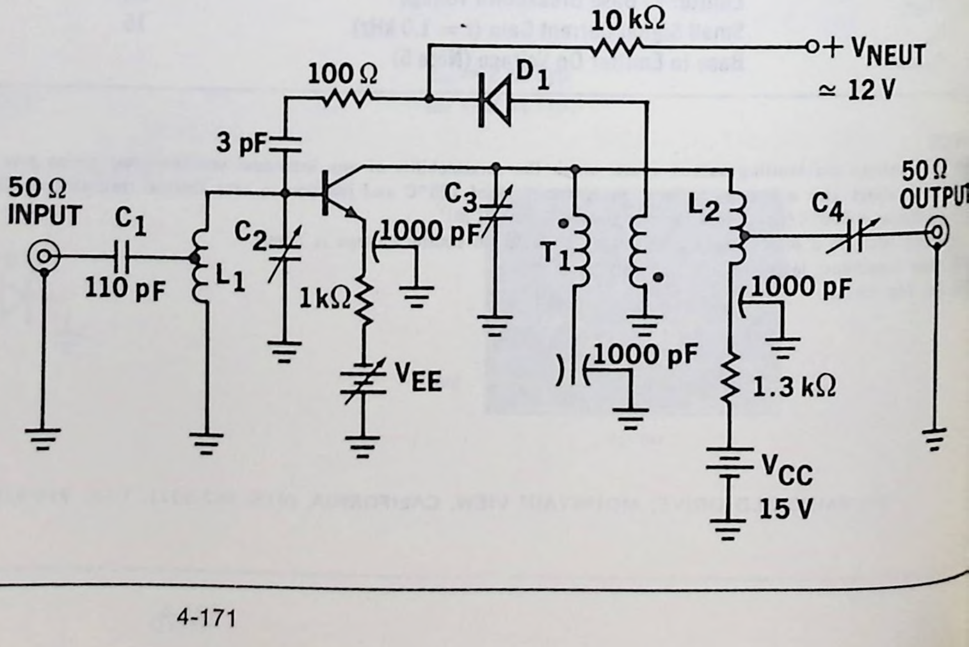
L_1 = 11 µH (0.9 inch of #632 AIRDUX COIL)
Input Tap at 2.9T from cold side
Output Tap at 3.66T from cold side

L_2 = 1.1 µH (1.5 inches of #608 AIRDUX COIL)
Input Tap at 2.3T from cold side
Output Tap at 0.5T from cold side

All resistors are ½ watt.

Typical gain at I_C = 4 mA is 34 dB.

100 MHz AGC AND NF TEST CIRCUIT


10 kΩ
+ V_{NEUT}
≃ 12 V
100 Ω
D_1
3 pF
50 Ω INPUT
C_1
110 pF
L_1
C_2
C_3
1000 pF
1kΩ
V_{EE}
T_1
1000 pF
L_2
C_4
50Ω OUTPUT
1000 pF
1.3 kΩ
V_{CC}
15 V

L_1 = #14 Buss Wire — 3T — ⅜" I.D. — 5/12" long
Tap at 1½T from cold end

L_2 = #18 enameled — 5T — ⅜" I.D. — 5/16" long
Tap at 1½T from cold end

T_1 = #36 Bifilar — 1T in balum core Q_3

C_2 = 1 to 35 pF Johanson #803 (or equivalent)

C_3, C_4 = 1 to 35 pF Johanson #803 (or equivalent)

D_1 — FD 300

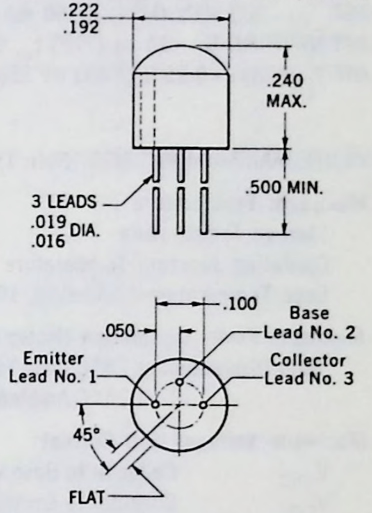
2N5127

NPN RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH FREQUENCY - - $f_T = 750$ MHz (TYP) AT 15 mA**
- **LOW CAPACITY - - $C_{cb} = 3.5$ pF (MAX), 2.5 pF (TYP) AT 10 V**
- **LOW NOISE - - NF = 3.7 dB (TYP) AT 1.0 MHz**

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	+260°C Maximum
Maximum Power Dissipation (Note 2)	
Total Dissipation at 25°C Case Temperature	0.5 Watt
at 25°C Ambient Temperature	0.2 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	20 Volts
V_{CEO} Collector to Emitter Voltage (Note 3)	12 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	$I_C = 100\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	$I_E = 100\ \mu A$	$I_C = 0$
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	12			Volts	$I_C = 10$ mA	$I_B = 0$
$V_{CE}(sat)$	Collector Saturation Voltage			0.3	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage			1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
I_{CBO}	Collector Cutoff Current			50	nA	$V_{CB} = 10$ V	$I_E = 0$
I_{CBO} (65°C)	Collector Cutoff Current			5.0	μA	$V_{CB} = 10$ V	$I_E = 0$
h_{FE}	DC Pulse Current Gain (Note 4)	15	35	300		$I_C = 2.0$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 4)		70			$I_C = 15$ mA	$V_{CE} = 10$ V
h_{fe}	Low Frequency Current Gain (f = 1 kHz)	12	80	400		$I_C = 2.0$ mA	$V_{CE} = 10$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**1.5**	**3.0**			**$I_C = 2.0$ mA**	**$V_{CE} = 10$ V**
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**		**7.5**			**$I_C = 15$ mA**	**$V_{CE} = 10$ V**
r_{bb}'	Real Part of h_{ie} (f = 350 MHz)		30		Ω	$I_C = 15$ mA	$V_{CE} = 10$ V
C_{cb}	**Collector-Base Capacitance**		**2.5**	**3.5**	**pF**	**$V_{CB} = 10$ V**	**$I_E = 0$**
NF	**Noise Figure (f = 1.0 MHz)**		**3.7**		**dB**	**$I_C = 2.0$ mA** **$R_S = 50\Omega$**	**$V_{CE} = 10$ V**
$V_{BE}(on)$	Base to Emitter On Voltage (Note 4)			1.0	Volts	$I_C = 10$ mA	$V_{CE} = 10$ V

*Planar is a patented Fairchild process.

OTES:
- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/watt (derating factor of 2.0 mW/°C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N5128 • 2N5129

NPN CLASS-C RF AMPLIFIERS AND HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH GAIN - - 400 mW RF POWER OUT AT 30 MHz (TYP)**
- **BETA - - 35 (MIN) AT 50 mA, 20 (MIN) AT 10 mA**
- **HIGH f_T - - 200 MHz (MIN) AT 50 mA**
- **FAST SWITCHING - - 14 ns (TYP) t_{on} AND 80 ns (TYP) t_{off} AT 300 mA**
- **LOW V_{CE}(sat) - - 0.25 V (MAX) AT 150 mA, 0.35 V (TYP) AT 500 mA**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature		
Storage Temperature		−55°C to +125°C
Operating Junction Temperature		+125°C
Lead Temperature (Soldering, 10 second time limit)		+260°C
Maximum Power Dissipation (Notes 2 and 3)	**2N5128**	**2N5129**
Total Dissipation at 25°C Case Temperature	0.7 Watt	0.5 Watt
at 25°C Ambient Temperature	0.3 Watt	0.2 Watt
Maximum Voltages and Current	**2N5128**	**2N5129**
V_{CBO} Collector to Base Voltage	15 Volts	15 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	12 Volts	12 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts	3.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
G_{PE}	**Amplifier Power Gain (f = 30 MHz)** (Note 7)		12		dB	$I_C = 0$ (zero signal)	$V_{CE} = 15$ V
η	Collector Efficiency (f = 30 MHz) (Note 7)		75		%	$I_C = 0$ (zero signal)	$V_{CE} = 15$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	2.0		8.0		$I_C = 50$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	20	85			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	35	75	350		$I_C = 50$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)		62			$I_C = 500$ mA	$V_{CE} = 10$ V
t_{on}	**Turn On Time** (Note 6)		14		ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	**Turn Off Time** (Note 6)		80		ns	$I_C \approx 300$ mA $I_{B2} \approx 30$ mA	$I_{B1} \approx 30$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C) for 2N5129 and junction to case thermal resistance of 143°C/Watt (derating factor of 7.0 mW/°C) and a junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C) for 2N5128.

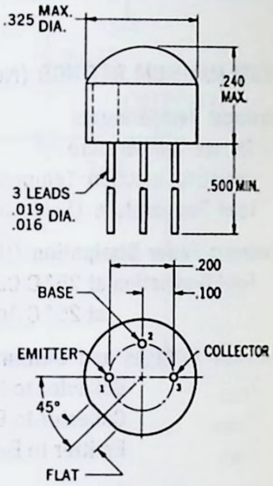
(4) This rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

(7) $P_{IN} = 40$ mW. See Test Circuit.

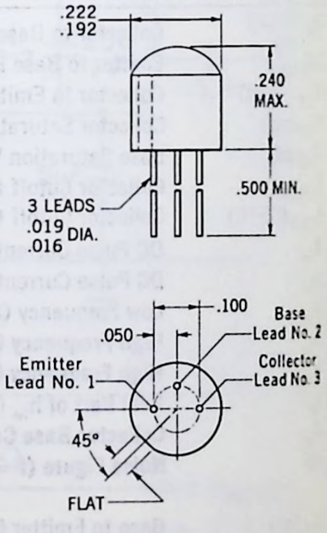
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

2N5128

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

2N5129

*Planar is a patented Fairchild process

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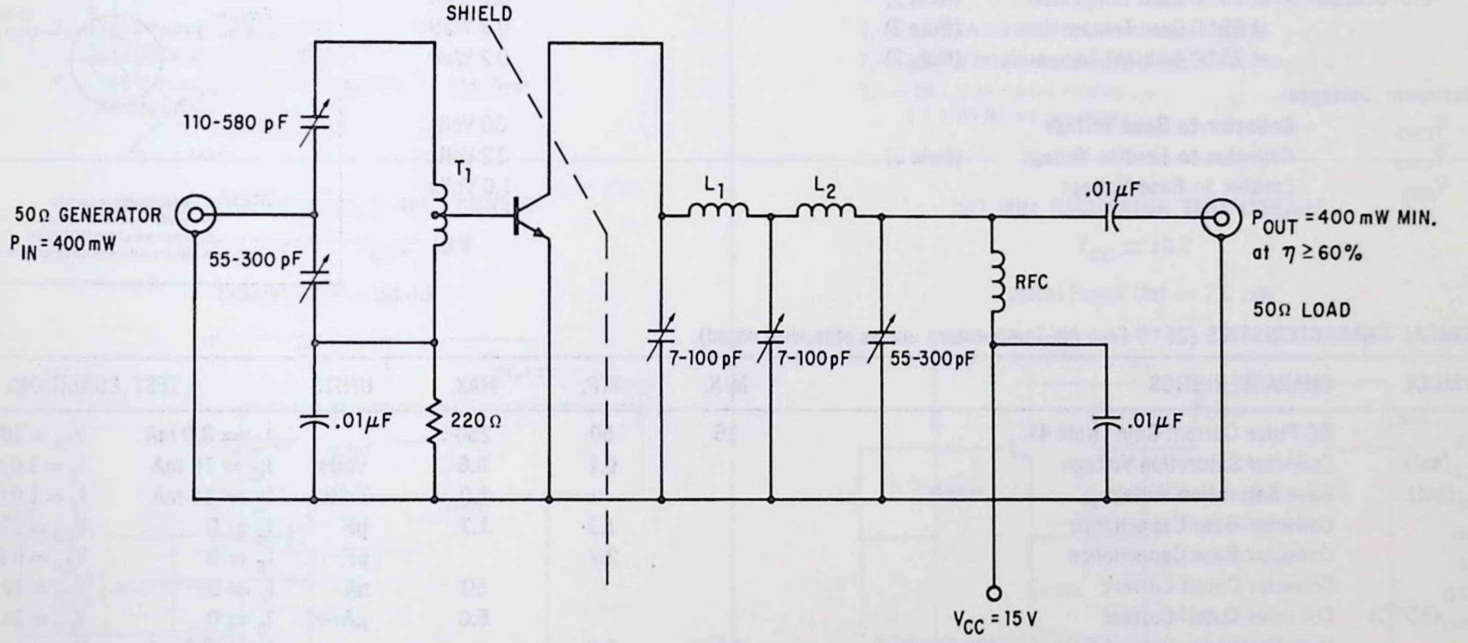
ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CES}	Collector to Emitter Breakdown Voltage	15			Volts	$I_C = 10\ \mu A$	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	15			Volts	$I_C = 10\ \mu A$	$I_E = 0$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	12			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	$I_C = 0$	$I_E = 10\ \mu A$
C_{cb}	Collector-Base Capacitance (f = 1.0 MHz)			10	pF	$I_E = 0$	$V_{CB} = 10$ V
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		0.13	0.25	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		0.35		Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE}(sat)	Pulsed Emitter Saturation Voltage (Note 5)			1.10	Volts	$I_C = 150$ mA	$I_B = 15$ mA
I_{CBO}	Collector Cutoff Current			0.05	μA	$V_{CE} = 10$ V	$V_{EB} = 0$
I_{CBO}(65°C)	Collector Cutoff Current			1.0	μA	$V_{CE} = 10$ V	$V_{EB} = 0$
V_{BE}(on)	Base to Emitter On Voltage (Note 5)			1.1	Volts	$I_C = 150$ mA	$V_{CE} = 5.0$ V

30 MHz AMPLIFIER TEST CIRCUIT


SHIELD
110-580 pF
T1
50Ω GENERATOR
P_IN = 400 mW
55-300 pF
.01μF
220Ω
L1
L2
.01μF
P_OUT = 400 mW MIN.
at η ≥ 60%
50Ω LOAD
RFC
7-100 pF
7-100 pF
55-300 pF
.01μF
V_CC = 15 V

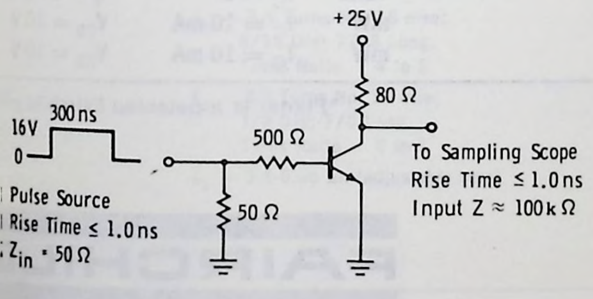
T₁ - 4 Turns No. 20 Wire, ¾″ Dia. x ¼″ Long, Midtapped.

L₁ and L₂ - 4 Turns No. 20 Wire, ½″ Dia. x ¼″ Long.

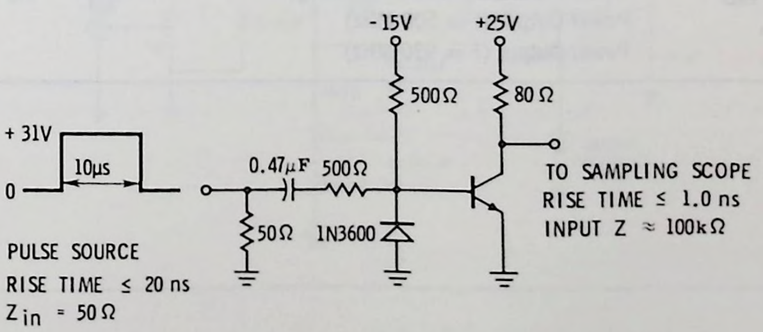
Variable Capacitors are Compression Mica.

$R_G = 140\ \Omega$, $R_L = 260\ \Omega$ as seen by transistor.

TURN-ON TEST CIRCUIT


+25 V
80 Ω
16V
300 ns
0
500 Ω
To Sampling Scope
Rise Time ≤ 1.0 ns
Input Z ≈ 100k Ω
50 Ω
Pulse Source
Rise Time ≤ 1.0 ns
Z_in = 50 Ω

TURN-OFF TEST CIRCUIT


-15V
+25V
500Ω
80 Ω
+ 31V
10μs
0
0.47μF
500Ω
TO SAMPLING SCOPE
RISE TIME ≤ 1.0 ns
INPUT Z ≈ 100k Ω
50Ω
1N3600
PULSE SOURCE
RISE TIME ≤ 20 ns
Z_in = 50 Ω

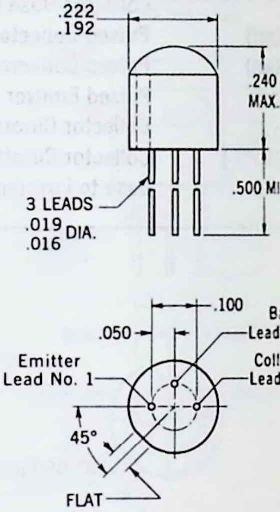
2N5130

NPN LOW LEVEL RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH GAIN . . . . $G_{pe} = 15$ dB (TYP) AT 200 MHz**
- **HIGH POWER OUTPUT . . . $P_o = 40$ mW (TYP) AT 500 MHz**
  $P_o = 7.0$ mW (TYP) AT 930 MHz
- **LOW NOISE . . . . NF = 4.0 dB (TYP) AT 60 MHz**
- **BREAKDOWN VOLTAGE . . . $LV_{CEO} = 12$ V (MIN)**

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) out



NOTES: All dimensions in inches
All leads electrically isolated from ca
Package weight is 0.31 gram. Package
is electrically non-conductive mater

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−55°C to +125°C
Operating Junction Temperature		+125°C Maximum
Soldering Temperature (10 second time limit)		+260°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature	(Note 2)	0.5 Watt
at 65°C Case Temperature	(Note 2)	0.3 Watt
at 25°C Ambient Temperature	(Note 2)	0.2 Watt
Maximum Voltages		
V_{CBO} Collector to Base Voltage		30 Volts
V_{CEO} Collector to Emitter Voltage	(Note 3)	12 Volts
V_{EBO} Emitter to Base Voltage		1.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	15	50	250		$I_C = 8.0$ mA	$V_{CE} = 10$ V
V_{CE}(sat)	Collector Saturation Voltage		0.1	0.6	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage			1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
C_{cb}	Collector-Base Capacitance		1.3	1.7	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{cb}	Collector-Base Capacitance		2.7		pF	$I_E = 0$	$V_{CB} = 0$ V
I_{CBO}	Collector Cutoff Current			50	nA	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}(65°C)	Collector Cutoff Current			5.0	μA	$I_E = 0$	$V_{CB} = 10$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	4.5	9.0			$I_C = 8.0$ mA	$V_{CE} = 10$ V
G_{pe}	Available Power Gain (neutralized) (Note 5) (f = 200 MHz)		17		dB	$I_C = 8.0$ mA	$V_{CE} = 10$ V
NF	Noise Figure (f = 60 MHz)		4.0		dB	$I_C = 1.0$ mA $R_S = 400\ \Omega$	$V_{CE} = 6.0$ V
$r_b'C_c$	Collector-Base Time Constant (f = 79.8 MHz)		15		ps	$I_C = 8.0$ mA	$V_{CB} = 10$ V
V_{BE}(on)	Base to Emitter On Voltage			1.0	Volts	$I_C = 10$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	12		300		$I_C = 8.0$ mA	$V_{CE} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_E = 0$	$I_C = 100$ μA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	12			Volts	$I_C = 3.0$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	1.0			Volts	$I_C = 0$	$I_E = 10$ μA
P_o	Power Output (f = 500 MHz)		40		mW	$I_C = 10$ mA	$V_{CB} = 10$ V
P_o	Power Output (f = 930 MHz)		7.0		mW	$I_C = 10$ mA	$V_{CB} = 10$ V

*Planar is a patented Fairchild proc

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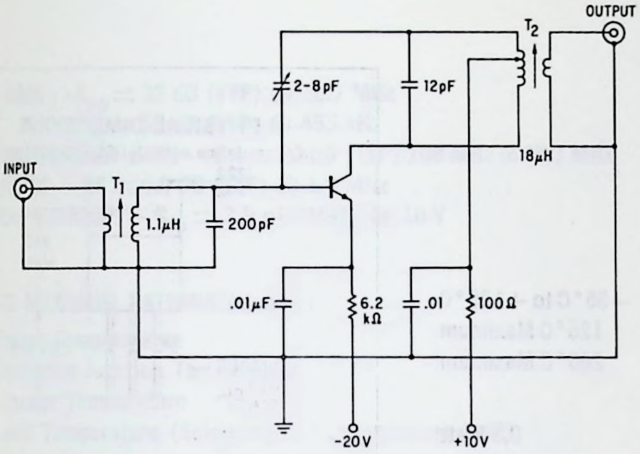
FAIRCHILD TRANSISTOR 2N5130

NEUTRALIZED 10.7 MHz I.F. TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10$ V

Typical Gain = 37 dB



INPUT
T1
1.1μH
200pF
2-8pF
12pF
T2
OUTPUT
18μH
.01μF
6.2 kΩ
.01
100Ω
-20V
+10V

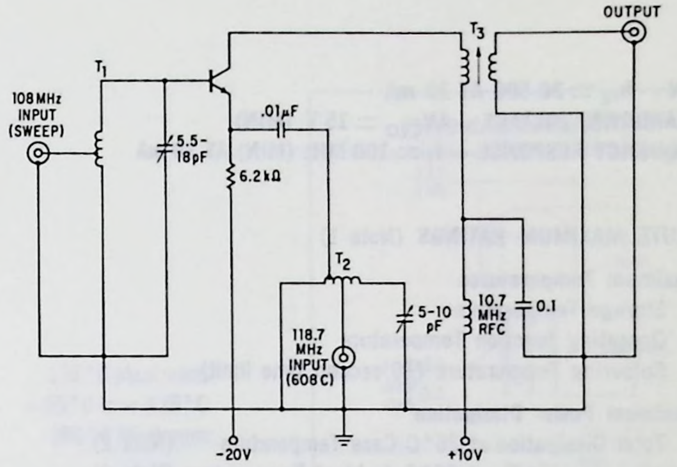
T_1 = 2.6 T Primary #26 Nyclad
10 T Secondary #26 Nyclad

T_2 = 38 T Primary #36 Nyclad tapped at 25 T for Neut.
2.5 Secondary #26 Nyclad

10.8 MHz TO 10.7 MHz CONVERSION GAIN TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10$ V

Typical Gain = 25 dB



108 MHz INPUT (SWEEP)
T1
5.5-18pF
.01μF
6.2kΩ
T3
OUTPUT
T2
118.7 MHz INPUT (608C)
5-10 pF
10.7 MHz RFC
0.1
-20V
+10V

T_1 = 3 T #16 tinned copper wire, tapped at 1 T

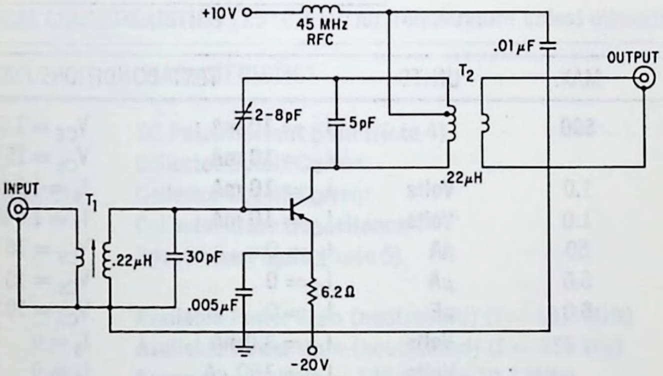
T_2 = 2.5 T #16 tinned copper wire, tapped at 0.5 and 1 T

T_3 = 10 T #26 Nyclad Primary
1 T #26 Nyclad Secondary

NEUTRALIZED 45 MHz I.F. TEST CIRCUIT

$I_C = 3.0$ mA $V_{CE} = 10$ V

Typical Gain = 28 dB



+10V
45 MHz RFC
.01μF
T2
OUTPUT
2-8pF
5pF
.22μH
INPUT
T1
.22μH
30pF
.005μF
6.2Ω
-20V

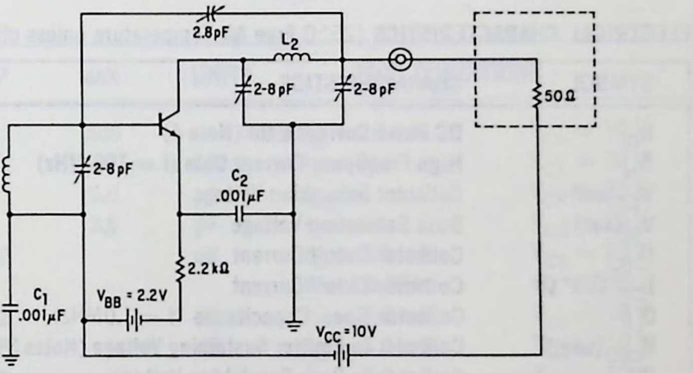
T_1 = 1.2 T Primary #26 Nyclad
4.5 T Secondary #26 Nyclad } Miller #30-106 Core

T_2 = 11 T Primary #26 Nyclad tapped at 4 T for Neut.
1 T Secondary

930 MHz OSCILLATOR TEST CIRCUIT

$V_{CC} = 10$ V

Typical Power Out = 7.0 mW



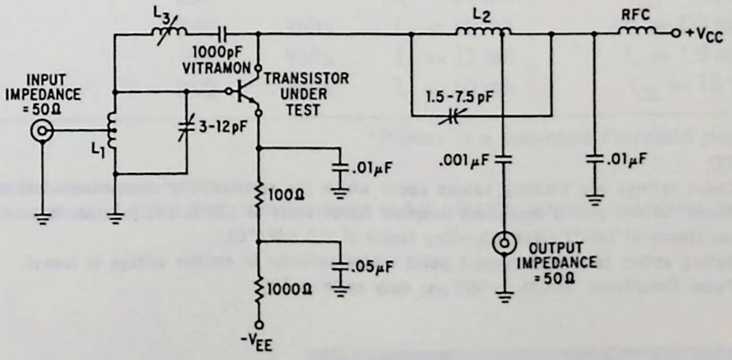
2.8pF
L2
2-8pF
2-8pF
50Ω
L1
2-8pF
C2
.001μF
2.2kΩ
C1
.001μF
VBB = 2.2V
VCC = 10V

C_1 and C_2 are feed-through capacitors.

L_1 and L_2 are silver tubing with mutual coupling.

This circuit is meant to be used with an attenuator and a filter. The collector supply is fed in through the attenuator.

NEUTRALIZED 200 MHz POWER GAIN AMPLIFIER TEST CIRCUIT



L3
1000pF VITRAMON
TRANSISTOR UNDER TEST
INPUT IMPEDANCE = 50Ω
L1
3-12pF
L2
1.5-7.5pF
RFC
+VCC
.01μF
.001μF
.01μF
100Ω
.05μF
1000Ω
OUTPUT IMPEDANCE = 50Ω
-VEE

L_1 — 3.5 Turns No. 16 wire;
5/16 Dia; 7/16 Long.
Turns Ratio 4 to 2

L_2 — 8.0 Turns No. 16 wire;
1/8 Dia; 7/8 Long.
Turns Ratio 8 to 1

L_3 — 0.4-0.65 μh (adjustable core)

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW°/C).

Rating refers to a high-current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle ≤ 1%.

Forward gain (dB) + reverse gain (dB) < (−20 dB). See test circuit.

2N5131

NPN GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTORS

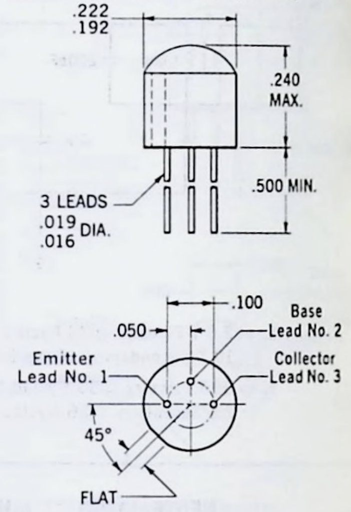
- **GAIN - - h_{FE} = 30-500 AT 10 mA**
- **BREAKDOWN VOLTAGE - - LV_{CEO} = 15 V (MIN)**
- **FREQUENCY RESPONSE - - f_T = 100 MHz (MIN) AT 10 mA**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	125°C Maximum
Soldering Temperature (10 second time limit)	260°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Note 2)	0.5 Watt
at 25°C Ambient Temperature (Note 2)	0.2 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	20 Volts
V_{CEO} Collector to Emitter Voltage (Note 3)	15 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 4)	**30**	**500**		**I_C = 10 mA**	V_{CE} = 1.0 V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**1.0**			**I_C = 10 mA**	V_{CE} = 15 V
V_{CE}(sat)	Collector Saturation Voltage		1.0	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(sat)	Base Saturation Voltage		1.0	Volts	I_C = 10 mA	I_B = 1.0 mA
I_{CBO}	Collector Cutoff Current		50	nA	I_E = 0	V_{CB} = 10 V
I_{CBO}(65°C)	Collector Cutoff Current		5.0	μA	I_E = 0	V_{CB} = 10 V
C_{cb}	Collector-Base Capacitance (f = 1.0MHz)		6.0	pF	I_E = 0	V_{CB} = 10 V
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 3 and 4)	**15**		**Volts**	**I_C = 3.0 mA**	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	20		Volts	I_C = 100 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		Volts	I_C = 0	I_E = 10 μA
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	25	600		I_C = 10 mA	V_{CE} = 10 V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient th resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(3) Rating refers to a high-current point where collector to emitter voltage is lowest.
(4) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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2N5132

NPN AM/FM AMPLIFIER

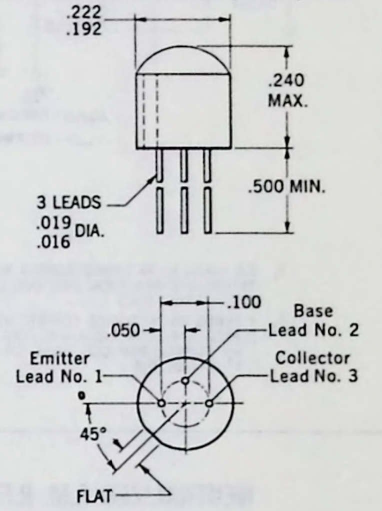
DIFFUSED SILICON PLANAR* TRANSISTOR

IGH GAIN - - A_{pg} = 32 dB (TYP) @ 10.7 MHz
A_{pg} = 55 dB (TYP) @ 455 kHz
IGH CONVERSION GAIN - - G_C = 20 dB (TYP) 108 MHz to 10.7 MHz
OW NOISE - - NF = 4.0 dB (TYP) @ 1.0 MHz
OW CAPACITANCE - - C_{cb} = 3.5 pF (MAX) @ 10 V

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Operating Junction Temperature		125°C Maximum
Storage Temperature		−55°C to +125°C
Lead Temperature (Soldering, 10 second time limit)		260°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Note 2)		0.5 Watt
at 25°C Ambient Temperature (Note 2)		0.2 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	20 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 4)	30		400		I_C = 10 mA	V_{CE} = 10 V
I_{CBO}	Collector Cutoff Current			50	nA	I_E = 0	V_{CB} = 10 V
I_{CBO}(65°C)	Collector Cutoff Current			5.0	μA	I_E = 0	V_{CB} = 10 V
C_{cb}	**Collector-Base Capacitance**			**3.5**	**pF**	I_E = 0	V_{CB} = 10 V
NF	**Spot Noise Figure** (Note 5)		**4.0**		**dB**	I_C = 3.0 mA f = 1.0 MHz	V_{CE} = 10 V R_S = 300 Ω
A_{pg}	**Available Power Gain** (neutralized) **(f = 10.7 MHz)**		**32**		**dB**	I_C = 7.0 mA	V_{CE} = 10 V
A_{pg}	**Available Power Gain** (neutralized) **(f = 455 kHz)**		**55**		**dB**	I_C = 3.0 mA	V_{CE} = 10 V
G_{CC}	**Conversion Gain (f = 108 MHz to 10.7 MHz)**		**20**		**dB**	I_C = 7.0 mA	V_{CE} = 10 V
$r_b'C_c$	Collector-Base Time Constant (f = 80 MHz)		30		ps	I_C = 10 mA	V_{CE} = 15 V
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	I_C = .01 mA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 3)	20			Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_E = .01 mA	I_C = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0	3.5			I_C = 10 mA	V_{CE} = 15 V
h_{fe}	Low Frequency Current Gain (f = 1.0 kHz)	20		650		I_C = 10 mA	V_{CE} = 10 V
V_{BE}(sat)	Base Saturation Voltage (Note 5)			0.90	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)			2.0	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE}(on)	Base to Emitter On Voltage (Note 5)			0.90	Volts	I_C = 10 mA	V_{CE} = 10 V

*Planar is a patented Fairchild process.

TES:
These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°/Watt (derating factor of 2.0 mW/°C).
Rating refers to a high-current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.

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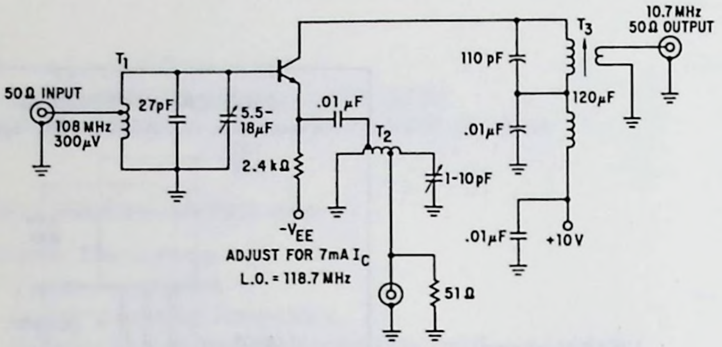
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

108 MHz TO 10.7 MHz CONVERSION GAIN TEST CIRCUIT

$I_C = 7.0$ mA $\quad V_{CE} = 10V$

TYPICAL CONVERSION GAIN = 20 dB


T1
50Ω INPUT
108 MHz
300μV
27pF
5.5-18μF
.01 μF
T2
2.4 kΩ
1-10pF
-VEE
ADJUST FOR 7mA IC
L.O. = 118.7 MHz
51 Ω
110 pF
T3
10.7 MHz
50Ω OUTPUT
120μF
.01μF
.01μF
+10V

T1 2.5 TURNS No. 16 TINNED COPPER WIRE TAPPED 2 TURNS FROM GND. COIL DIA. 3/8" (INSIDE DIA.).

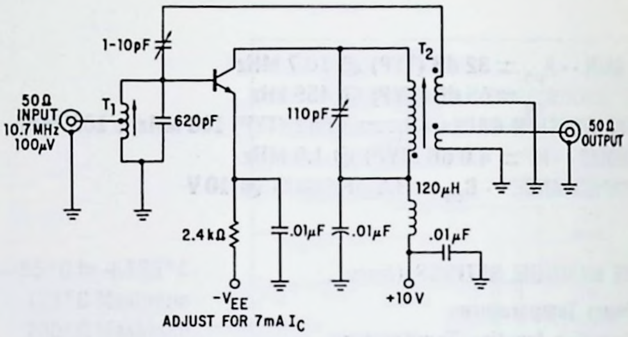
T2 4 TURNS No. 16 TINNED COPPER WIRE TAPPED 3/4 TURN FROM GND. AND 1 1/4 TURNS FROM GND. COIL DIA. 1/4" (INSIDE DIA.).

T3 MILLER COIL FORM
MILLER CORE No. 30-106
PRIMARY...10 TURNS No. 36 ENAMELED WIRE.
SECONDARY...1 1/3 TURNS No. 28 ENAMELED WIRE.

10.7 MHz NEUTRALIZED POWER GAIN TEST CIRCUIT

$I_C = 7.0$ mA $\quad V_{CE} = 10V$

TYPICAL GAIN = 32 dB


1-10pF
50Ω
INPUT
10.7 MHz
100μV
T1
620pF
110pF
T2
50Ω
OUTPUT
120μH
2.4 kΩ
.01μF
.01μF
.01μF
-VEE
ADJUST FOR 7mA IC
+10V

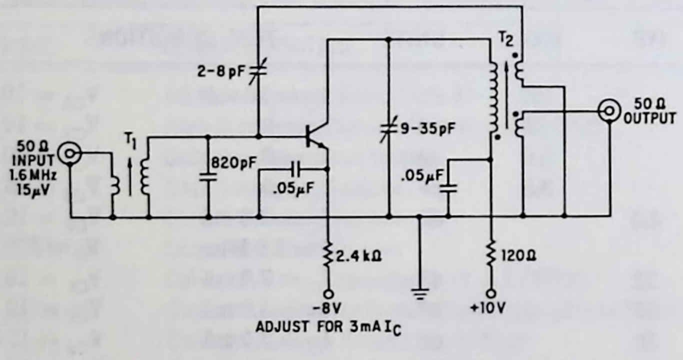
T1 MILLER COIL FORM
MILLER CORE No. 30-106
4 TURNS No. 28 ENAMELED WIRE TAPPED 1.5 TURNS FROM GND.

T2 MILLER COIL FORM
MILLER CORE No. 30-106
PRIMARY...10 TURNS No. 36 ENAMELED WIRE.
NEUT. SEC....5 TURNS No. 36 ENAMELED WIRE (BIFILAR).
OUTPUT SEC....1.33 TURNS No. 28 ENAMELED WIRE (OVERWIND).

NEUTRALIZED A.M. R.F. AMPLIFIER TEST CIRCUIT

$I_C = 3.0$ mA $\quad V_{CE} = 10V$

TYPICAL GAIN = 46 dB


2-8 pF
T2
50 Ω
OUTPUT
9-35pF
50 Ω
INPUT
1.6 MHz
15μV
T1
820pF
.05μF
.05μF
2.4 kΩ
120Ω
-8V
ADJUST FOR 3mA IC
+10V

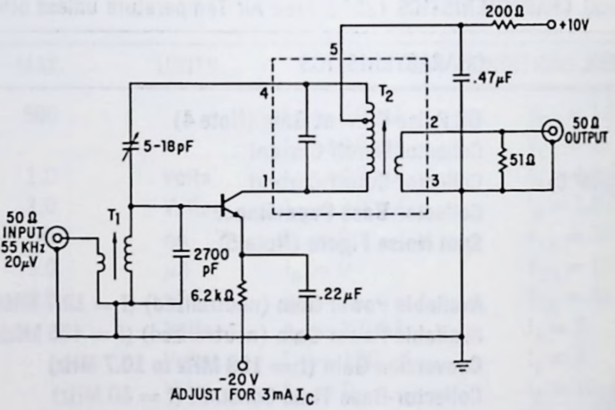
T1 28 T No. 36 NYCLAD SECONDARY
6 T No. 28 NYCLAD PRIMARY
MILLER No. 80-106 CORE

T2 120 T No. 40 S.S. ENL. PRIMARY
40 T No. 40 S.S. ENL. NEUT. SEC.
7 T No. 28 NYCLAD OUTPUT SEC., WAVE WOUND BIFILAR WITH COLD END OF PRIMARY.

455 kHz NEUTRALIZED A.M. I.F. AMPLIFIER TEST CIRCUIT

$I_C = 3.0$ mA $\quad V_{CE} = 10V$

TYPICAL GAIN = 55 dB


200Ω
+10V
5
.47μF
4
T2
2
1
3
50 Ω
OUTPUT
51Ω
5-18pF
50 Ω
INPUT
455 KHz
20μV
T1
2700 pF
6.2 kΩ
.22μF
-20V
ADJUST FOR 3mA IC

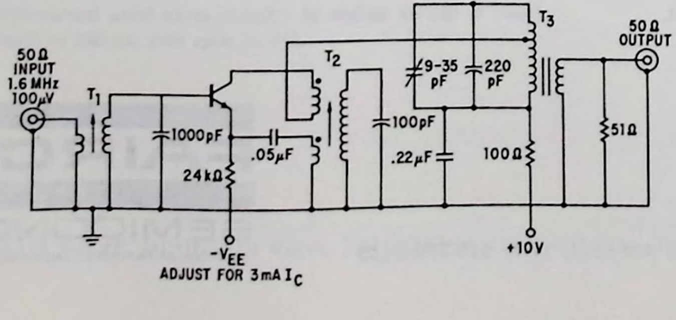
T1 13 T PRIMARY No. 26 NYCLAD
54 T SECONDARY No. 36 NYCLAD
.043 mh
MILLER No. 30-106 CORE

T2 MILLER MIN. I.F. TRANSFORMER No. 2032.

1.6 MHz TO 455 kHz AUTODYNE CONVERSION GAIN TEST CIRCUIT

$I_C = 2.0\text{-}3.0$ mA $\quad V_{CE} = 10V$

TYPICAL GAIN = 42 dB


50 Ω
INPUT
1.6 MHz
100μV
T1
1000pF
24kΩ
-VEE
ADJUST FOR 3mA IC
T2
.05μF
100pF
.22μF
9-35 pF
220 pF
T3
100 Ω
50 Ω
OUTPUT
51Ω
+10V

T1 MILLER COIL FORM
MILLER SLUG No. 30-106 CORE
PRIMARY...6 T No. 28 ENAMELED WIRE
SECONDARY...28 T No. 36 ENAMELED WIRE

T2 MILLER COIL FORM
MILLER CORE No. 30-106
4 TURNS No. 28 ENAMELED WIRE
1 1/2 TURNS No. 28 ENAMELED WIRE
60 TURNS No. 36 ENAMELED WIRE

T3 MILLER No. 2032 455 kHz TRANSFORMER CENTER CORE ONLY

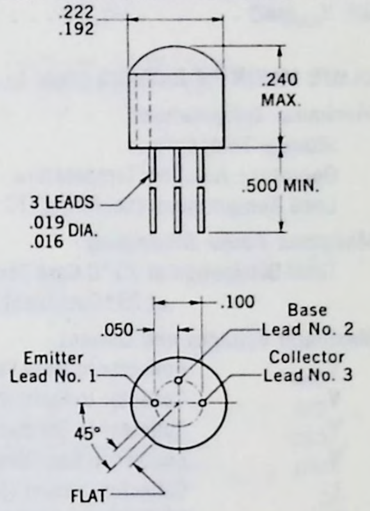
2N5133

NPN HIGH-GAIN, LOW-NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

LOW NOISE - - NF = 1.5 dB (TYP) @ 1.0 kHz
HIGH GAIN - - h_{FE} = 60 (MIN), 220 (TYP) @ 1.0 mA
h_{FE} = 50 (TYP) @ 50 μA
BREAKDOWN VOLTAGE - - LV_{CEO} = 18 VOLTS (MIN)

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Operating Junction Temperature	125°C Maximum
Storage Temperature	−55°C to +125°C
Lead Temperature (Soldering, 10 second time limit)	260°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Note 2)	0.5 Watt
at 25°C Ambient Temperature (Note 2)	0.2 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	20 Volts
V_{CEO} Collector to Emitter Voltage (Note 3)	18 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	**60**	**220**	**1000**		**I_C = 1.0 mA**	**V_{CE} = 5.0 V**
h_{FE}	**DC Current Gain**		**50**			**I_C = 50 μA**	**V_{CE} = 10 V**
h_{fe}	High Frequency Current Gain (f = 20 MHz)		1.3			I_C = 50 μA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0		20		I_C = 1.0 mA	V_{CE} = 5.0 V
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**		1.5		dB	**I_C = 30 μA** **PWR BW = 200 Hz**	**V_{CE} = 5.0 V** **R_S = 10 kΩ**
V_{CE}(sat)	Collector Saturation Voltage			0.4	Volts	I_C = 1.0 mA	I_B = 0.1 mA
I_{CBO}	Collector Cutoff Current			50	nA	I_E = 0	V_{CB} = 15 V
I_{CBO}(65°C)	Collector Cutoff Current			5.0	μA	I_E = 0	V_{CB} = 15 V
C_{cb}	Collector-Base Capacitance			5.0	pF	I_E = 0	V_{CB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 3 and 4)	**18**			**Volts**	**I_C = 3.0 mA**	**I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_E = 10 μA	I_C = 0
V_{BE}(on)	Base to Emitter On Voltage			0.75	Volts	I_C = 100 μA	V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50		1100		I_C = 1.0 mA	V_{CE} = 5.0 V

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(3) Rating refers to a high-current point where collector to emitter voltage is lowest.

(4) Pulse Conditions: length = 300 μs; duty cycle = 1%.

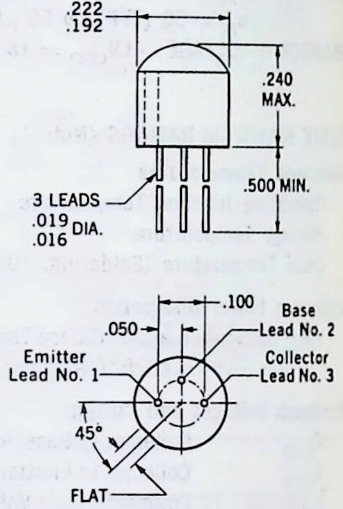
2N5134

NPN HIGH-SPEED SATURATED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH FREQUENCY CURRENT GAIN . . .** $f_T = 400$ MHz (MIN)
- **LOW CAPACITANCE . . . .** $C_{cb} = 4$ pF (MAX)
- **LOW CHARGE STORAGE TIME . . . . . .** $\tau_S = 18$ ns (MAX)
- **LOW V_{CE}(sat) . . . .** 0.2 VOLT (MAX) AT 10 mA

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outlin



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Ambient Temperature	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	20 Volts
V_{CES}	Collector to Emitter Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage	10 Volts
V_{EBO}	Emitter to Base Voltage	3.5 Volts
I_C	Collector Current (10 μs Pulse)	500 mA
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	20	66	150		$I_C = 10$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	15	71			$I_C = 30$ mA	$V_{CE} = 0.4$ V
h_{FE}	DC Pulse Current Gain (Note 5)		40			$I_C = 100$ mA	$V_{CE} = 1.0$ V
V_{BE}(sat)	Base Saturation Voltage	0.70	0.80	0.90	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage	0.72	0.85	1.10	Volts	$I_C = 10$ mA	$I_B = 3.3$ mA
V_{BE}(sat)	Base Saturation Voltage		0.90		Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE}(sat)	Base Saturation Voltage		1.10		Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{CE}(sat)	**Collector Saturation Voltage**		**0.14**	**0.25**	**Volts**	**$I_C = 10$ mA**	**$I_B = 1.0$ mA**
V_{CE}(sat)	Collector Saturation Voltage		0.12	0.20	Volts	$I_C = 10$ mA	$I_B = 3.3$ mA
V_{CE}(sat)	Collector Saturation Voltage		0.17		Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{CE}(sat) (+65°C)	Collector Saturation Voltage		0.19		Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	Collector Saturation Voltage		0.28		Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain (f= 100 MHz)**	**2.5**	**5.75**			**$I_C = 10$ mA**	**$V_{CE} = 10$ V**
C_{cb}	**Collector-Base Capacitance**		**2.3**	**4.0**	**pF**	**$I_E = 0$**	**$V_{CB} = 5.0$ V**
I_{CES}	Collector Reverse Current		0.05	0.40	μA	$V_{CE} = 15$ V	$V_{BE} = 0$
I_{CBO}(65°C)	Collector Cutoff Current		1.0	10	μA	$I_E = 0$	$V_{CB} = 15$ V
BV_{CES}	Collector to Emitter Breakdown Voltage	20			Volts	$I_C = 10$ μA	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	$I_C = 10$ μA	$I_E = 0$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	10			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.5			Volts	$I_C = 0$	$I_E = 10$ μA
τ_s	**Charge Storage Time Constant** (Note 6)		**7.0**	**18**	ns	**$I_C = I_{B1} \approx 10$ mA, $I_{B2} \approx -10$ mA**	
t_{on}	Turn On Time (Note 6)		8.0	18	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3.3$ mA	
t_{off}	Turn Off Time (Note 6)		7.0	18	ns	$I_C \approx 10$ mA, $I_{B1} \approx 3.3$ mA, $I_{B2} \approx -3.3$ mA	

*Planar is a patented Fairchild proce

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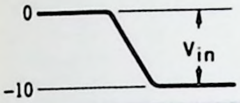
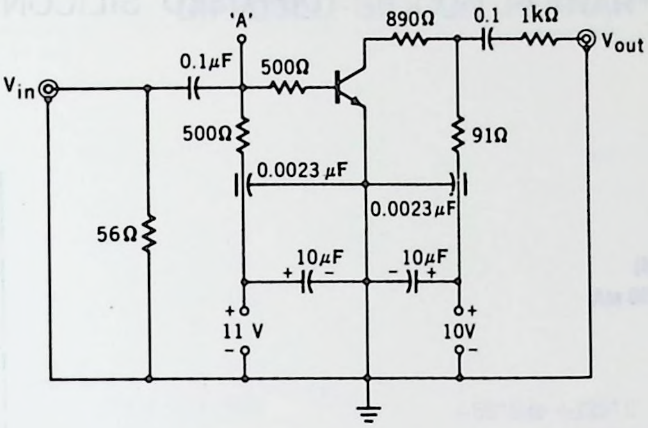
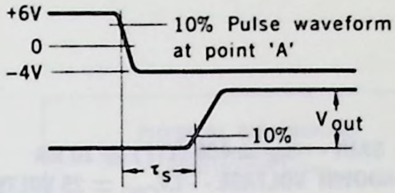
FAIRCHILD TRANSISTOR 2N5134

CHARGE STORAGE TIME MEASUREMENT CIRCUIT



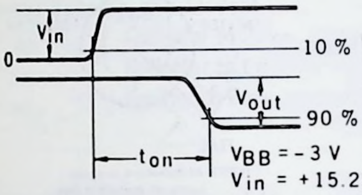
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %


'A'
890Ω
0.1
1kΩ
V_{out}
0.1μF
500Ω
V_{in}
500Ω
91Ω
0.0023 μF
0.0023μF
56Ω
10μF
10μF
+
−
+
11 V
−
10V
−

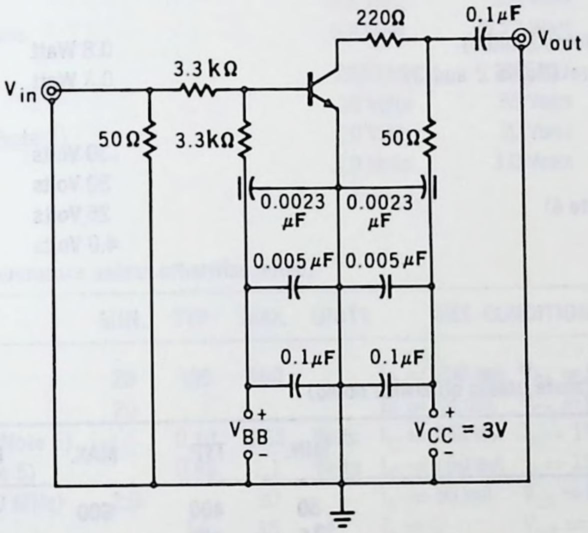

+6V
0
−4V
10% Pulse waveform at point 'A'
V_{out}
10%
τ_S

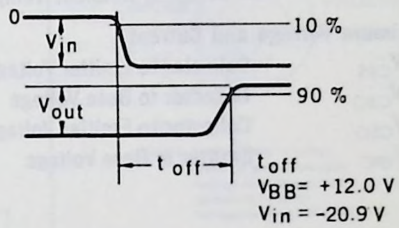
To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

t_{ON} — t_{OFF} MEASUREMENT CIRCUIT


V_{in}
0
10 %
V_{out}
90 %
t_{on}
V_{BB} = −3 V
V_{in} = +15.25V

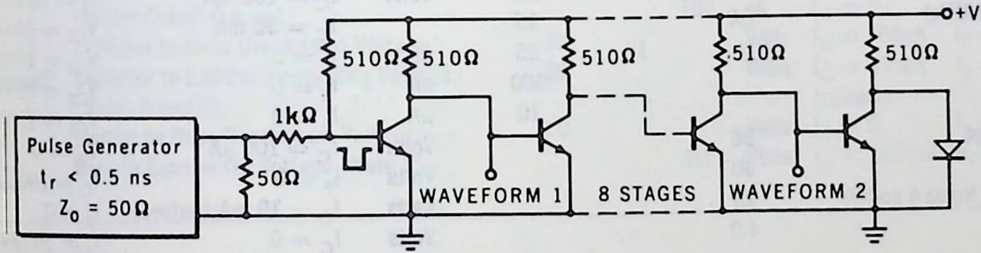
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %

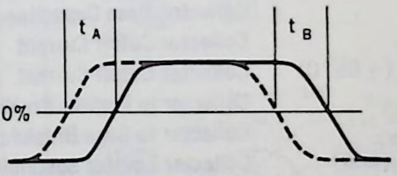

220Ω
0.1μF
V_{out}
3.3 kΩ
V_{in}
50Ω
3.3kΩ
50Ω
0.0023 μF
0.0023 μF
0.005μF
0.005μF
0.1μF
0.1μF
+
V_{BB}
−
+
V_{CC} = 3V
−


0
10 %
V_{in}
V_{out}
90 %
t_{off}
t_{off}
V_{BB}= +12.0 V
V_{in} = -20.9 V

To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY


+V_{CC}
510Ω
510Ω
510Ω
510Ω
510Ω
1kΩ
Pulse Generator
t_r < 0.5 ns
Z_0 = 50 Ω
50Ω
WAVEFORM 1
8 STAGES
WAVEFORM 2



Waveforms 1 and 2 Superimposed

$$\bar{t}_{pd} = \frac{t_A + t_B}{20}$$

$\bar{t}_{pd}$ = Average Propagation per Transistor

S:

ese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
ese are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
ese ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C). Junction to ambient ermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
ating refers to a high-current point where collector to emitter voltage is lowest.
ulse Conditions: length = 300 μs; duty cycle = 1%.
e switching circuits for exact value of I_C, I_{B1}, and I_{B2}.

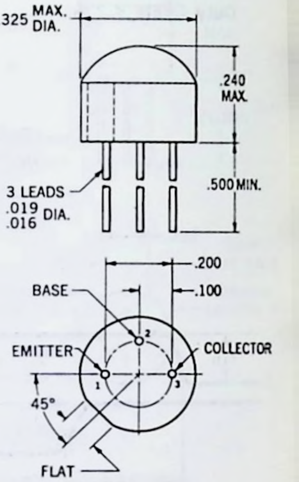
2N5135

NPN HIGH GAIN AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **HIGH GAIN - - h_{FE} = 400 (TYP) @ 10 mA**
- **BREAKDOWN VOLTAGE - - LV_{CEO} = 25 VOLTS (MIN)**
- **FREQUENCY RESPONSE - - f_T = 40 MHz (MIN) @ 30 mA**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−55°C to +125°C
Operating Junction Temperature		+125°C Maximum
Lead Temperature (Soldering, 10 second time limit)		+260°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)		0.8 Watt
at 25°C Ambient Temperature (Notes 2 and 3)		0.3 Watt
Maximum Voltage and Current		
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	25 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	**50**	**400**	**600**		**$I_C = 10$ mA**	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	15	325			$I_C = 2.0$ mA	$V_{CE} = 10$ V
V_{BE}	Base-Emitter Voltage (Note 5)		0.87	1.0	Volts	$I_C = 100$ mA	$V_{CE} = 1.0$ V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.9	1.0	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)			1.0	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**2.0**		**15**		**$I_C = 30$ mA**	$V_{CE} = 10$ V
C_{cb}	Collector-Base Capacitance		13	25	pF	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}	Collector Cutoff Current			300	nA	$I_E = 0$	$V_{CB} = 15$ V
I_{CBO}(+65°C)	Collector Cutoff Current			10	µA	$I_E = 0$	$V_{CB} = 15$ V
BV_{CES}	Collector to Emitter Breakdown Voltage	30			Volts	$I_C = 100$ µA	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_E = 0$	$I_C = 100$ µ
V_{CEO}(sust)	**Collector Emitter Sustaining Voltage** (Notes 4 and 5)	**25**			**Volts**	**$I_C = 10$ mA** (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	$I_C = 0$	$I_E = 10$ µA
V_{BE}	Base to Emitter Voltage (Note 5)			1.0	Volts	$I_C = 100$ mA	$V_{CE} = 1.0$ V

*Planar is a patented Fairchild pro

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal sistance of 333°C/Watt (derating factor of 3.0 mW/°C).
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 µs; duty cycle ≤ 1%.

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2N5136 • 2N5137

NPN GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} - - 20 VOLTS (MIN)
- $_{FE}$ - - - 20-400 AT 150 mA
- $_{CE}$(sat) - - 0.25 VOLT (MAX) AT 150 mA

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature		
Storage Temperature		−55°C to +125°C
Operating Junction Temperature		+125°C
Lead Temperature (Soldering, 10 second time limit)		+260°C
Maximum Power Dissipation (Notes 2 and 3)	**2N5136**	**2N5137**
Total Dissipation at 25°C Case Temperature	0.8 Watt	0.6 Watt
at 25°C Ambient Temperature	0.3 Watt	0.22 Watt
Maximum Voltages and Current	**2N5136**	**2N5137**
V_{CBO} Collector to Base Voltage	30 Volts	30 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	20 Volts	20 Volts
V_{EBO} Emitter to Base Voltage	3.0 Volts	3.0 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

YMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$_{FE}$	**DC Pulse Current Gain** (Note 5)	**20**	**100**	**400**		$I_C = 150$ mA	$V_{CE} = 1.0$ V
$_{FE}$	DC Pulse Current Gain (Note 5)	20				$I_C = 30$ mA	$V_{CE} = 1.0$ V
$_{CE}$(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		0.10	**0.25**	**Volts**	$I_C = 150$ mA	$I_B = 15$ mA
$_{BE}$(sat)	Pulsed Base Saturation Voltage (Note 5)		0.85	1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$_{fe}$	High Frequency Current Gain (f = 20 MHz)	2.0		20		$I_C = 50$ mA	$V_{CE} = 5.0$ V
$_{cb}$	Collector-Base Capacitance		16	35	pF	$I_E = 0$	$V_{CB} = 10$ V
$_{eb}$	Emitter Base Capacitance		63	85	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$_{CBO}$	Collector Cutoff Current			100	nA	$I_E = 0$	$V_{CB} = 20$ V
$_{CBO}$(65°C)	Collector Cutoff Current			10	μA	$I_E = 0$	$V_{CB} = 20$ V
$_{EBO}$	Emitter Cutoff Current			100	nA	$I_C = 0$	$V_{EB} = 2.0$ V
V_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 100\mu$A	$I_E = 0$
$_{CEO}$(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**20**			**Volts**	$I_C = 10$ mA (pulsed)	$I_B = 0$
V_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	$I_C = 0$	$I_E = 10$ μA
$_{BE}$(on)	Base to Emitter On Voltage (Note 5)			1.1	Volts	$I_C = 150$ mA	$V_{CE} = 1.0$ V

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

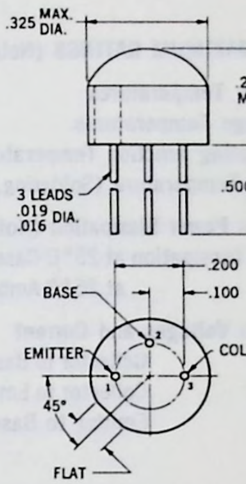
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 167°C/Watt (derating factor of 6.0 mW/°C); junction to ambient thermal resistance of 455°C/Watt (derating factor of 2.2 mW/°C) for 2N5137 and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C) for 2N5136.

This rating refers to a high current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

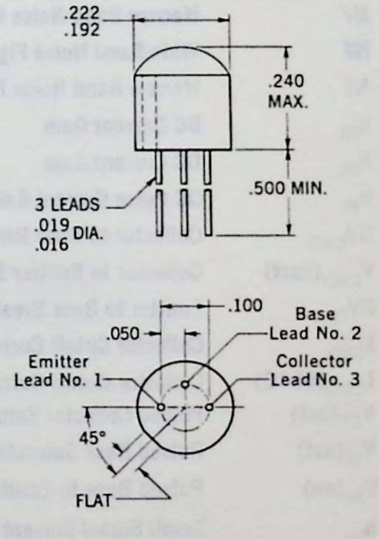
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

2N5136

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package is electrically non-conductive material

2N5137

*Planar is a patented Fairchild process.

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2N5138

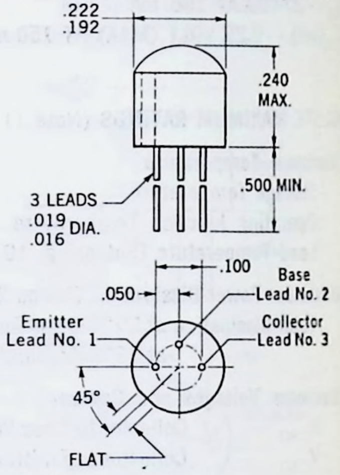
PNP LOW-LEVEL AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **LOW NOISE FIGURE . . . . 0.7 dB (TYP) AT f = 1 kHz**
- **HIGH CURRENT GAIN . . . $h_{FE} = 100$ (TYP) AT $I_C = 100\ \mu A$**
- **HIGH BREAKDOWN . . . . . $LV_{CEO} = 30$ V (MIN)**
- **EXCELLENT BETA LINEARITY FROM 1 μA TO 50 mA**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperatures	−55° to +125°C
Operating Junction Temperatures	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	0.5 Watt
at 25°C Ambient Temperature	0.2 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	−30 Volts
V_{CEO} Collector to Emitter Voltage	−30 Volts
V_{EBO} Emitter to Base Voltage	−5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5138 MIN.	 TYP.	 MAX.	UNITS	TEST CONDITIONS	
NF	**Narrow Band Noise Figure (f = 1.0 kHz) (Note 6)**		0.7		dB	$I_C = 20\ \mu A$	$V_{CE} = -5.0$ V
NF	**Wide Band Noise Figure (Note 7)**		1.0		dB	$I_C = 20\ \mu A$	$V_{CE} = -5.0$ V
NF	Narrow Band Noise Figure (f = 1.0 kHz) (Note 8)		0.8		dB	$I_C = 250\ \mu A$	$V_{CE} = -5.0$ V
h_{FE}	**DC Current Gain**	50	100	800		$I_C = 100\ \mu A$	$V_{CE} = -10$ V
h_{FE}	DC Current Gain	50	110			$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{FE}	**DC Pulse Current Gain (Note 5)**	50	120			$I_C = 10$ mA	$V_{CE} = -10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	−30			Volts	$I_C = 100\ \mu A$	$I_E = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage (Notes 4 and 5)**	−30			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	$I_C = 0$	$I_E = 100\ \mu A$
I_{CBO}	**Collector Cutoff Current**			10	nA	$I_E = 0$	$V_{CB} = -20$ V
I_{CBO}(65°C)	Collector Cutoff Current			3.0	μA	$I_E = 0$	$V_{CB} = -20$ V
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)			−0.3	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)			−1.0	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{BE}(on)	Pulsed Base to Emitter "On" Voltage (Note 5)		−0.74	−1.0	Volts	$I_C = 10$ mA	$V_{CE} = -10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	40		1000		$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	1.5				$I_C = 0.5$ mA	$V_{CE} = -5.0$ V
C_{cb}	Collector to Base Capacitance			7.0	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{eb}	Emitter to Base Capacitance			30	pF	$I_C = 0$	$V_{EB} = -0.5$ V

*Planar is a patented Fairchild proces

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FAIRCHILD TRANSISTOR 2N5138

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low-duty cycle operations.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(4) This rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) Rs = 10 kΩ, Power Bandwidth of 150 Hz.

(7) Rs = 10 kΩ, Power Bandwidth of 15.7 kHz with 3.0 dB points at 10 Hz and 10 kHz.

(8) Rs = 1.0 kΩ, Power Bandwidth of 150 Hz.

2N5139

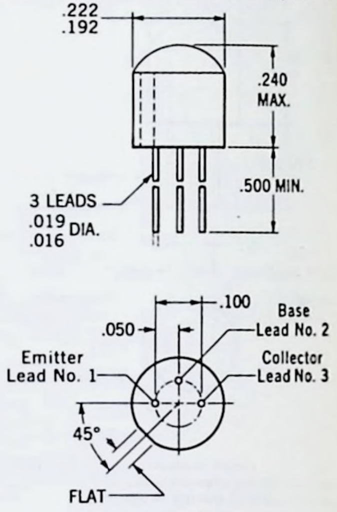
PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH BETA . . . . $h_{FE} = 150$ (TYP) AT 10 mA**
- **HIGH FREQUENCY . . . $f_T = 500$ MHz (TYP) AT 10 mA**
- **LOW CAPACITANCE . . . $C_{cb} = 2.2$ pF (TYP)**
- **HIGH VOLTAGE . . . . . $LV_{CEO} = 20$ VOLTS (MIN)**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package
is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	+260°C Maximum
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	0.5 Watt
at 25°C Ambient Temperature	0.2 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	−20 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	−20 Volts
V_{EBO} Emitter to Base Voltage	−5.0 Volts
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	30	70			$I_C = 100\ \mu A$	$V_{CE} = -10$ V
h_{FE}	DC Current Gain	40	100			$I_C = 1.0$ mA	$V_{CE} = -10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	40	150			$I_C = 10$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	15	30			$I_C = 50$ mA	$V_{CE} = -10$ V
V_{CE}(sat)	Collector Saturation Voltage			−0.15	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)			−0.20	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		−0.2	−0.5	**Volts**	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)	−0.7	−0.77	−1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		−0.75	−1.25	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
t_{on}	**Turn On Time** (Note 6)			50	**ns**	$I_C \approx 50$ mA	$I_{B1} \approx 5.0$ mA
t_{off}	**Turn Off Time** (Note 6)			200	**ns**	$I_C \approx 50$ mA	$I_{B1} \approx 5.0$ mA $I_{B2} \approx -5.0$ mA
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	3.0	5.0			$I_C = 10$ mA	$V_{CE} = -20$ V

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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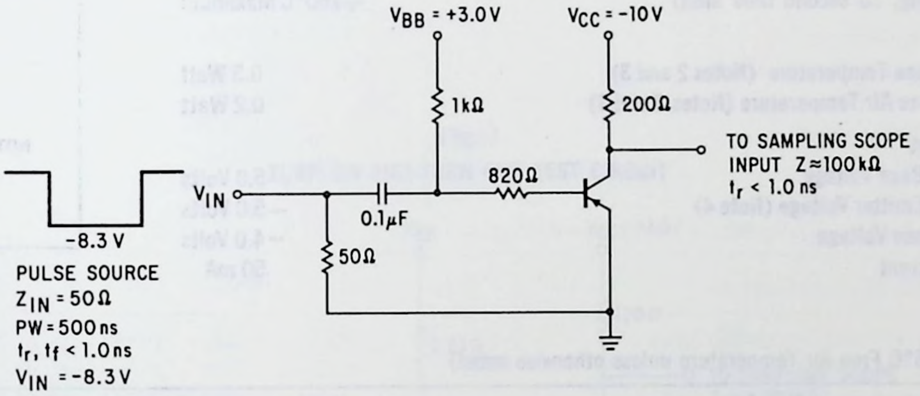
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTOR 2N5139

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	−20			**Volts**	**$I_C = 10$ mA (pulsed)**	**$I_B = 0$**
BV_{CBO}	Collector to Base Breakdown Voltage	−20			Volts	$I_C = 100\ \mu A$	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−20			Volts	$I_C = 100\ \mu A$	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	$I_C = 0$	$I_E = 100\ \mu A$
I_{CES}	Collector Reverse Current			50	nA	$V_{CE} = -15$ V	$V_{BE} = 0$
I_{CES}(+65°C)	Collector Reverse Current			25	μA	$V_{CE} = -15$ V	$V_{BE} = 0$
C_{cb}	**Collector to Base Capacitance**			5.0	pF	$I_E = 0$	**$V_{CB} = -10$ V**
C_{eb}	Emitter to Base Capacitance			8.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V

SWITCHING TIME TEST CIRCUIT


$V_{BB} = +3.0$ V
$V_{CC} = -10$ V
1kΩ
200Ω
TO SAMPLING SCOPE
INPUT Z≈100kΩ
$t_r < 1.0$ ns
V_{IN}
820Ω
0.1μF
50Ω
−8.3 V
PULSE SOURCE
$Z_{IN} = 50\Omega$
PW = 500ns
$t_r, t_f < 1.0$ns
$V_{IN} = -8.3$ V

2N5140

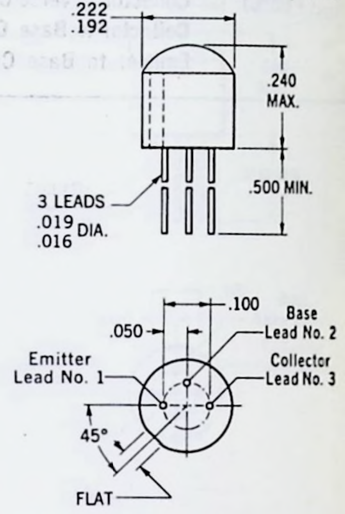
PNP ULTRA HIGH-SPEED SWITCH

SILICON PLANAR* EPITAXIAL TRANSISTOR

- **ULTRA HIGH SPEED . . . . $t_{on} = 20$ ns (MAX) AT $I_C \approx 10$ mA**
  $t_{off} = 20$ ns (MAX) AT $I_C \approx 10$ mA
- **LOW SATURATION VOLTAGE . . . V_{CE}(sat) = —0.2 V (MAX) AT $I_C = 10$ mA**
- **LOW CAPACITANCE . . . . $C_{cb} = 5.0$ pF (MAX)**
- **LOW LEAKAGE . . . . $I_{CES} = 50$ nA (MAX)**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	—55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	+260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	0.5 Watt
at 25°C Free Air Temperature (Notes 2 and 3)	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	—5.0 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	—5.0 Volts
V_{EBO}	Emitter to Base Voltage	—4.0 Volts
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
t_{on}	**Turn On Time** (Note 6, Fig. 1)		10	20	ns	$I_C \approx 10$ mA	$I_{B1} \approx 1.0$ mA
t_{off}	**Turn Off Time** (Note 6, Fig. 1)		13	20	ns	$I_C \approx 10$ mA	$I_{B1} \approx 1.0$ mA $I_{B2} \approx -1.0$ mA
τ_s	Charge Storage Time (Note 6, Fig. 2)		15		ns	$I_C \approx 10$ mA	$I_{B1} \approx 10$ mA $I_{B2} \approx -10$ mA
h_{FE}	**DC Pulse Current Gain** (Note 5)	20	50	140		$I_C = 10$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)		30			$I_C = 1.0$ mA	$V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain (Note 5)		70			$I_C = 50$ mA	$V_{CE} = -1.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	4.0	10			$I_C = 10$ mA	$V_{CE} = -5.0$ V
C_{cb}	**Collector to Base Capacitance**		2.0	5.0	pF	$V_{CB} = -5.0$ V	$I_E = 0$
C_{eb}	**Emitter to Base Capacitance**		2.5	5.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)		—0.88	—1.20	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 5)		—0.08	—0.2	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)		—0.20	—0.75	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA

*Planar is a patented Fairchild pro

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FAIRCHILD TRANSISTOR 2N5140

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

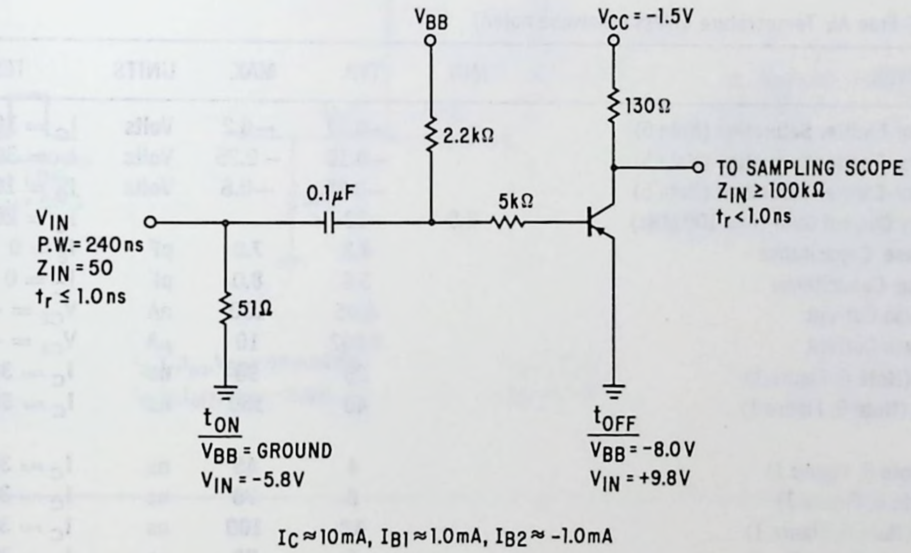
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{CES}	Collector Reverse Current		0.1	50	nA	$V_{CE} = -3.0$ V	$V_{BE} = 0$
$I_{CES}(+65°C)$	Collector Reverse Current		1.0	5.0	μA	$V_{CE} = -3.0$ V	$V_{BE} = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	−5.0			Volts	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	$I_C = 0$	$I_E = 100\ \mu$A
BV_{CES}	Collector to Emitter Breakdown Voltage	−5.0			Volts	$I_C = 100\ \mu$A	$V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−5.0			Volts	$I_C = 100\ \mu$A	$I_E = 0$

NOTES:

These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
This rating refers to a high-current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.
See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

Fig. 1

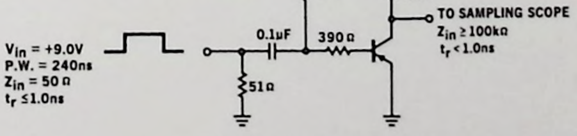
TURN ON AND TURN OFF TEST CIRCUIT



VBB
VCC = -1.5V
130Ω
2.2kΩ
TO SAMPLING SCOPE
ZIN ≥ 100kΩ
tr < 1.0ns
0.1μF
5kΩ
VIN
P.W. = 240ns
ZIN = 50
tr ≤ 1.0ns
51Ω
tON
VBB = GROUND
VIN = -5.8V
tOFF
VBB = -8.0V
VIN = +9.8V
IC ≈ 10mA, IB1 ≈ 1.0mA, IB2 ≈ -1.0mA

Fig. 2

CHARGE STORAGE TIME TEST CIRCUIT



VBB = -10V
VCC = -3.0V
0.1μF
0.1μF
510Ω
270Ω
TO SAMPLING SCOPE
Zin ≥ 100kΩ
tr < 1.0ns
0.1μF
390Ω
Vin = +9.0V
P.W. = 240ns
Zin = 50Ω
tr ≤ 1.0ns
51Ω
IC ≈ 10mA, IB1 ≈ 10mA, IB2 ≈ -10mA

2N5141

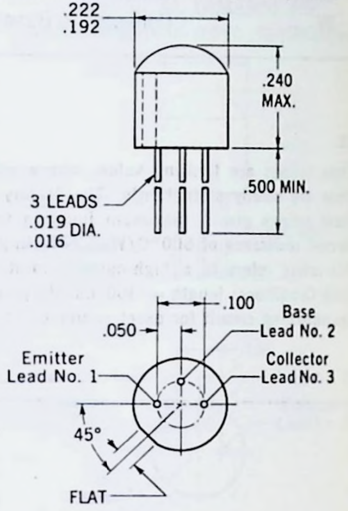
PNP HIGH-SPEED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **FAST SWITCHING TIME . . . . . $t_{on} = 90$ ns (MAX)**
  $t_{off} = 150$ ns (MAX)
- **LOW CAPACITANCE . . . . $C_{eb} = 8$ pF (MAX)**
  $C_{cb} = 7$ pF (MAX)
- **HIGH FREQUENCY . . . . $f_T = 300$ MHz (MIN)**
- **LOW SATURATION VOLTAGE . . . $V_{CE}(sat) = 0.2$ V (MAX)**

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram Package
is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−55°C to +125°C
Operating Junction Temperature		+125°C
Lead Temperature (Soldering, 10 second time limit)		+260°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature		0.5 Watt
at 25°C Ambient Temperature		0.2 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	−6.0 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−6.0 Volts
V_{EBO}	Emitter to Base Voltage	−6.0 Volts
V_{CES}	Collector to Emitter Voltage	−4.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CE}(sat)$	Pulsed Collector-Emitter Saturation (Note 5)		−0.07	−0.2	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE}(sat)$	Pulsed Collector-Emitter Saturation (Note 5)		−0.10	−0.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
$V_{CE}(sat)$	Pulsed Collector-Emitter Saturation (Note 5)		−0.25	−0.6	Volts	$I_C = 100$ mA	$I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	12			$I_C = 20$ mA	$V_{CE} = -5.0$ V
C_{cb}	Collector to Base Capacitance		3.3	7.0	pF	$I_E = 0$	$V_{CB} = -5.0$ V
C_{eb}	Emitter to Base Capacitance		3.8	8.0	pF	$I_C = 0$	$V_{EB} = -0.5$ V
I_{CES}	Collector Reverse Current		0.05	100	nA	$V_{CE} = -4.0$ V	$V_{EB} = 0$
$I_{CES}(65°C)$	Collector Reverse Current		0.002	10	μA	$V_{CE} = -4.0$ V	$V_{EB} = 0$
t_{on}	Turn On Time (Note 6, Figure 1)		25	90	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_{off}	Turn Off Time (Note 6, Figure 1)		40	150	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA $I_{B2} \approx -3.0$ mA
t_d	Delay Time (Note 6, Figure 1)		4	45	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_r	Rise Time (Note 6, Figure 1)		6	70	ns	$I_C \approx 30$ mA	$I_{B1} \approx 3.0$ mA
t_s	Storage Time (Note 6, Figure 1)		12	100	ns	$I_C \approx 30$ mA	$I_{B1} \approx I_{B2} \approx 3.0$ mA
t_f	Fall Time (Note 6, Figure 1)		3	70	ns	$I_C \approx 30$ mA	$I_{B1} \approx I_{B2} \approx 3.0$ mA

*Planar is a patented Fairchild proces

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C); junction to ambient therma resistance of 500°C/watt (derating factor of 2.0 mW/°C).
(4) This rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 200 μs; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

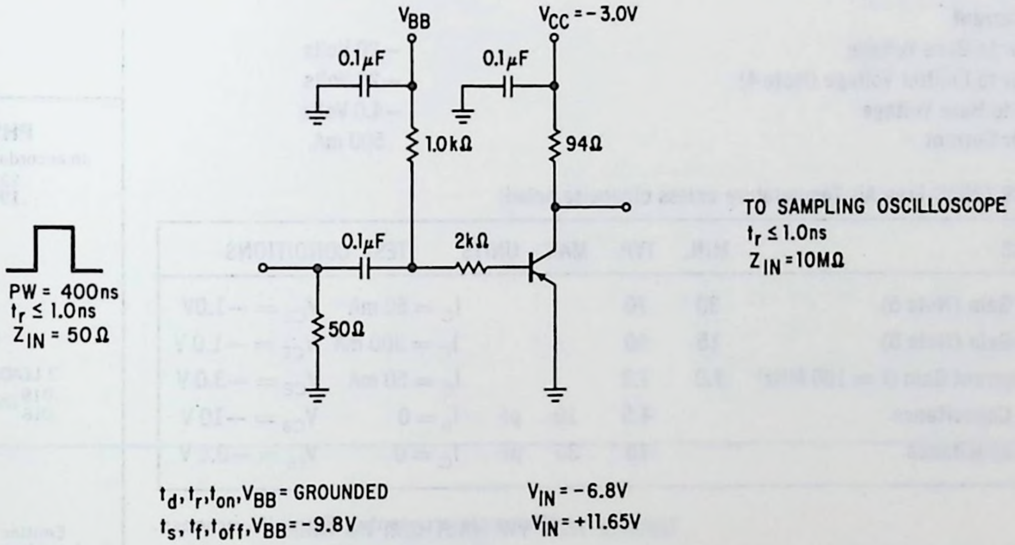
FAIRCHILD TRANSISTOR 2N5141

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{BE}(sat)	Pulsed Base-Emitter Saturation Voltage		−0.88	−1.1	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Pulsed Base-Emitter Saturation Voltage	−0.8	−0.93	−1.25	Volts	$I_C = 30$ mA	$I_B = 3.0$ mA
V_{BE}(sat)	Pulsed Base-Emitter Saturation Voltage		−1.14	−2.0	Volts	$I_C = 100$ mA	$I_B = 10$ mA
V_{CEO}(sust)	**Collector-Emitter Sustaining Voltage** (Notes 4 and 5)	**−6.0**			**Volts**	**$I_C = 10$ mA (pulsed)**	**$I_B = 0$**
BV_{CBO}	Collector-Base Breakdown Voltage	−6.0			Volts	$I_C = 100\ \mu$A	$I_E = 0$
BV_{EBO}	Emitter-Base Breakdown Voltage	−4.0			Volts	$I_E = 100\ \mu$A	$I_C = 0$
h_{FE}	**DC Pulse Current Gain**	**15**	**44**			**$I_C = 1.0$ mA**	**$V_{CE} = -2.0$ V**
h_{FE}	DC Pulse Current Gain (Note 5)	25	55			$I_C = 10$ mA	$V_{CE} = -2.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	63			$I_C = 30$ mA	$V_{CE} = -2.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**15**	**55**			**$I_C = 100$ mA**	**$V_{CE} = -5.0$ V**

SWITCHING TIME TEST CIRCUIT

(Figure 1)


V_BB
V_CC = −3.0V
0.1μF
0.1μF
1.0kΩ
94Ω
TO SAMPLING OSCILLOSCOPE
t_r ≤ 1.0ns
Z_IN = 10MΩ
0.1μF
2kΩ
PW = 400ns
t_r ≤ 1.0ns
Z_IN = 50Ω
50Ω
t_d, t_r, t_on, V_BB = GROUNDED
V_IN = −6.8V
t_s, t_f, t_off, V_BB = −9.8V
V_IN = +11.65V

2N5142 • 2N5143

PNP HIGH-CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **ULTRA-LOW COST PNP TRANSISTOR**
- **BETA** . . . . $h_{FE} = 30$ (MIN) AT 50 mA
  $h_{FE} = 15$ (MIN) AT 300 mA
- **LOW SATURATION VOLTAGE** . . . $V_{CE}(sat) = -0.08$ V (TYP) AT 50 mA
  $V_{CE}(sat) = -0.50$ V (TYP) AT 300 mA
- **FAST SWITCHING** . . . . $t_{on} = 30$ ns (TYP) AT 300 mA
  $t_{off} = 65$ ns (TYP) AT 300 mA
- **BREAKDOWN VOLTAGE** . . . . . . $LV_{CEO} = -20$ VOLTS (MIN) AT 10 mA

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C Maximum
Lead Temperature (Soldering, 10 second time limit)	+260°C Maximum

Maximum Power Dissipation (Notes 2 and 3)	**2N5142**	**2N5143**
Total Dissipation at 25°C Case Temperature	0.7 Watt	0.5 Watt
at 25°C Free Air Temperature	0.3 Watt	0.2 Watt

Maximum Voltages and Current

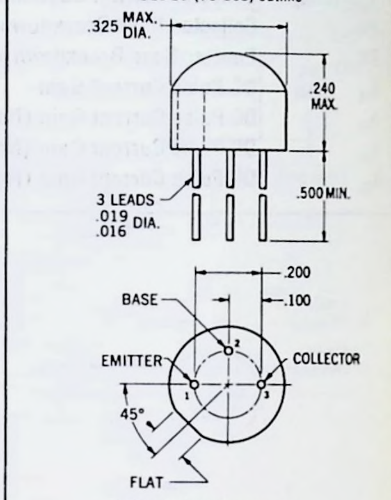
V_{CBO}	Collector to Base Voltage	−20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−20 Volts
V_{EBO}	Emitter to Base Voltage	−4.0 Volts
I_C	Collector Current	500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)	30	70			$I_C = 50$ mA $V_{CE} = -1.0$V
h_{FE}	DC Pulse Current Gain (Note 5)	15	50			$I_C = 300$ mA $V_{CE} = -1.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.0	1.9			$I_C = 50$ mA $V_{CE} = -3.0$ V
C_{cb}	Collector to Base Capacitance		4.5	10	pF	$I_E = 0$ $V_{CB} = -10$ V
C_{eb}	Emitter to Base Capacitance		15	30	pF	$I_C = 0$ $V_{EB} = -0.5$ V

*Planar is a patented Fairchild process.

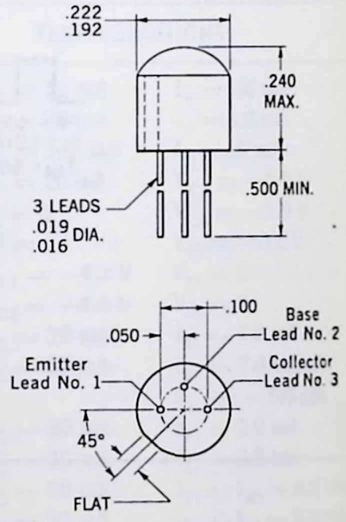
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

2N5142

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

2N5143

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/Watt (derating factor of 7.0 mW/°C) for the 2N5142; and 20 Watt (derating factor of 5.0 mW/°C) for the 2N5143, junction to ambient thermal resistance of 333°C/Watt (derating factor of 3.0 mW/°C) for the 2N5142; and 500°C/Wa (derating factor of 5.0 mW/°C) for the 2N5143.
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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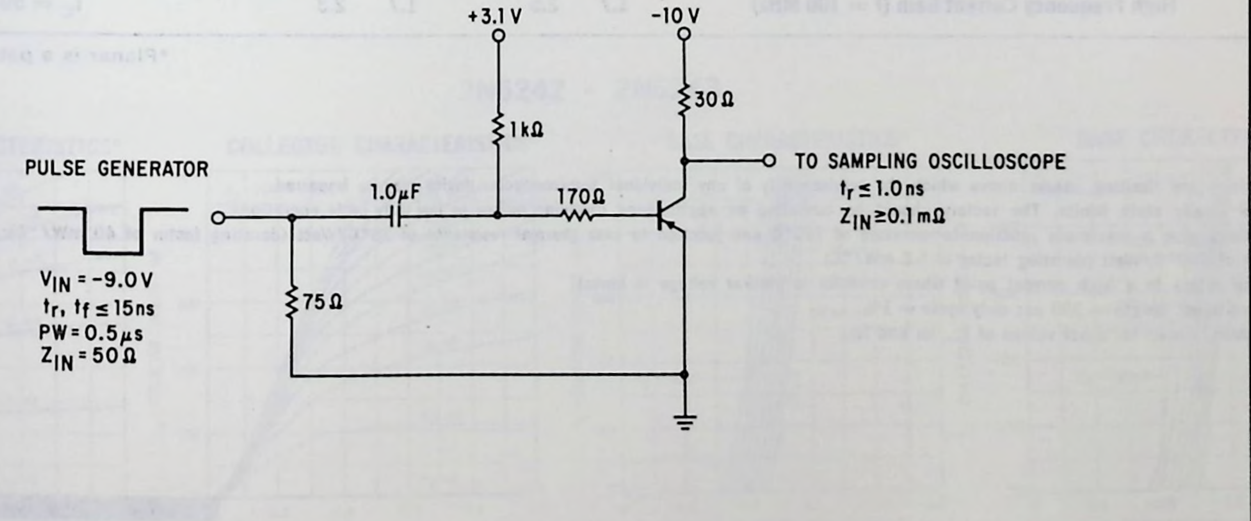
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS 2N5142 • 2N5143

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, Note 5)		−0.08	−0.5	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{CE}(sat)	Collector Saturation Voltage (Pulsed, Note 5)		−0.5	−2.0	Volts	$I_C = 300$ mA	$I_B = 30$ mA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	−20			Volts	$I_C = 10$ mA (pulsed)	$I_B = 0$
V_{BE}(sat)	Base Saturation Voltage (Pulsed, Note 5)		−0.9	−1.5	Volts	$I_C = 50$ mA	$I_B = 2.5$ mA
V_{BE}(sat)	Base Saturation Voltage (Pulsed, Note 5)	−0.8		−2.5	Volts	$I_C = 300$ mA	$I_B = 30$ mA
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	$I_C = 0$	$I_E = 100\ \mu$A
BV_{CBO}	Collector to Base Breakdown Voltage	−20			Volts	$I_C = 100\ \mu$A	$I_E = 0$
t_{on}	Turn On Time (Note 6)		30	100	ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	Turn Off Time (Note 6)		65	200	ns	$I_C \approx 300$ mA, $I_{B1} \approx 30$ mA, $I_{B2} \approx -30$ mA	
I_{CES}	Collector Reverse Current			35	nA	$V_{CE} = -12$ V	$V_{BE} = 0$
I_{CES}	Collector Reverse Current (+65°C)			2.0	μA	$V_{CE} = -12$ V	$V_{BE} = 0$

TURN ON AND TURN OFF TEST CIRCUIT



+3.1 V
-10 V
30 Ω
1 kΩ
PULSE GENERATOR
1.0 μF
170 Ω
TO SAMPLING OSCILLOSCOPE
tr ≤ 1.0 ns
ZIN ≥ 0.1 mΩ
VIN = -9.0 V
tr, tf ≤ 15 ns
PW = 0.5 μs
ZIN = 50 Ω
75 Ω

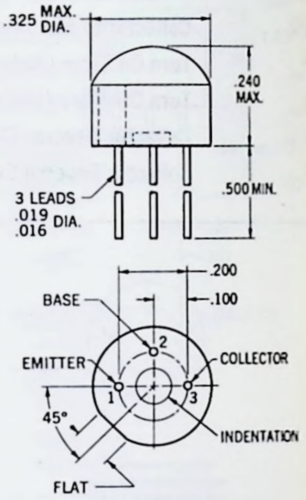
2N5242 • 2N5243

PNP HIGH-CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **FAST SWITCHING . . . . $t_{on} = 25$ ns (TYP) AT 500 mA**
  $t_{off} = 65$ ns (TYP) AT 500 mA
- **LOW SATURATION VOLTAGE . . . $V_{CE(sat)} = 0.75$ V (MAX) AT 1.0 A**
- **HIGH FREQUENCY . . . . $f_T = 250$ MHz (TYP) AT 50 mA**
- **HIGH BETA . . . . $h_{FE} = 25$ - 100 AT 500 mA**
  $h_{FE} = 50$ (TYP) AT 1.0 A

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature	−55°C to +125°C	
Operating Junction Temperature	+125°C	
Lead Temperature (soldering, 10 second time limit)	+260°C	
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature	4.0 Watts	
at 25°C Ambient Temperature	0.5 Watt	

Maximum Voltages and Current		**2N5242**	**2N5243**
V_{CBO}	Collector to Base Voltage	−20 Volts	−30 Volts
V_{CES}	Collector to Emitter Voltage	−20 Volts	−30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−20 Volts	−30 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C	Collector Current	1.0 Amp	1.0 Amp

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N5242			2N5243					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	−20			−30			Volts	$I_C = 10$ mA	$I_B = 0$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.22	−0.38		−0.24	−0.38	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)		**−0.33**	**−0.75**		**−0.33**	**−0.75**	**Volts**	**$I_C = 1.0$ A**	**$I_B = 100$ mA**
h_{FE}	DC Pulse Current Gain (Note 5)	25	50	100	25	45	100		$I_C = 500$ mA	$V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	**25**	**50**		25	45			**$I_C = 1.0$ A**	**$V_{CE} = -5.0$ V**
t_{on}	**Turn On Time** (Note 6)		**25**	**40**		**25**	**40**	**ns**	**$I_C \approx 500$ mA**	**$I_{B1} \approx 50$ mA**
t_{off}	**Turn Off Time** (Note 6)		**65**	**90**		**65**	**90**	**ns**	**$I_C \approx 500$ mA**	**$I_{B1} \approx 50$ mA** **$I_{B2} \approx -50$ m**
C_{cb}	Collector to Base Capacitance		20	35		18	35	pF	$I_E = 0$	$V_{CB} = -10$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**1.7**	**2.5**		1.7	2.3			**$I_C = 50$ mA**	**$V_{CE} = -10$ V**

*Planar is a patented Fairchild proce

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C); junction to ambient ther resistance of 200°C/Watt (derating factor of 5.0 mW/°C).
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

FAIRCHILD TRANSISTORS 2N5242 • 2N5243

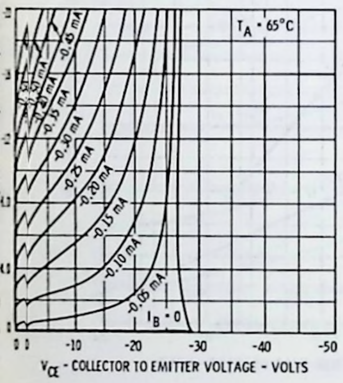
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5242 MIN.	2N5242 TYP.	2N5242 MAX.	2N5243 MIN.	2N5243 TYP.	2N5243 MAX.	UNITS	TEST CONDITIONS	
BV_{CBO}	Collector to Base Breakdown Voltage	−20			−30			Volts	$I_C = 100\ \mu A$	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−20			−30			Volts	$I_C = 100\ \mu A$	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			Volts	$I_C = 0$	$I_E = 100\ \mu A$
h_{FE}	DC Pulse Current Gain (Note 5)	15	45		15	40			$I_C = 100$ mA	$V_{CE} = -1.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.1	−0.2		−0.12	−0.2	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−0.8	−1.0		−0.8	−1.0	Volts	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)	−0.9	−1.02	−1.4	−0.9	−1.02	−1.4	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		−1.2	−1.75		−1.2	−1.75	Volts	$I_C = 1.0$ A	$I_B = 100$ mA
I_{CES}	Collector Reverse Current		6.0	100				nA	$V_{CE} = -10$ V	$V_{BE} = 0$
I_{CES}	Collector Reverse Current					8.0	100	nA	$V_{CE} = -20$ V	$V_{BE} = 0$
I_{CES}(65°C)	Collector Reverse Current		0.1	1.0				μA	$V_{CE} = -10$ V	$V_{BE} = 0$
I_{CES}(65°C)	Collector Reverse Current					0.15	1.0	μA	$V_{CE} = -20$ V	$V_{BE} = 0$
C_{eb}	Emitter to Base Capacitance		80	100		80	100	pF	$I_C = 0$	$V_{BE} = 0.5$ V

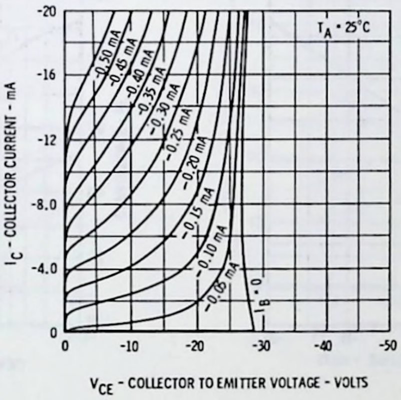
TYPICAL ELECTRICAL CHARACTERISTICS

2N5242

COLLECTOR CHARACTERISTICS*

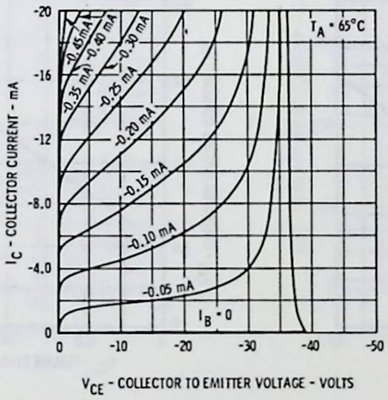


COLLECTOR CHARACTERISTICS*

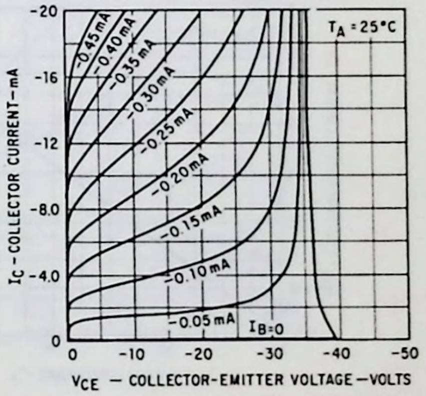


2N5243

COLLECTOR CHARACTERISTICS*

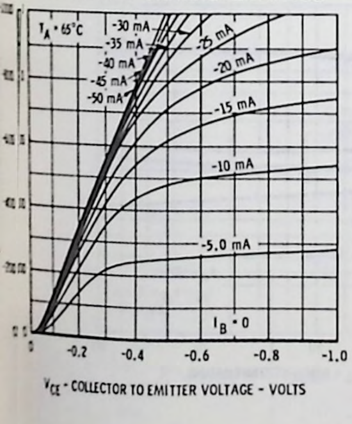


COLLECTOR CHARACTERISTICS*

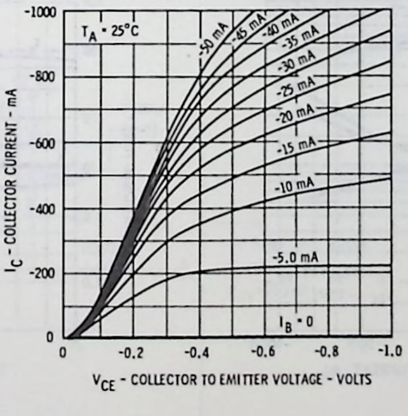


2N5242 • 2N5243

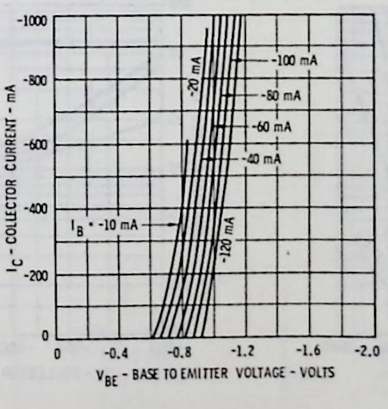
COLLECTOR CHARACTERISTICS*



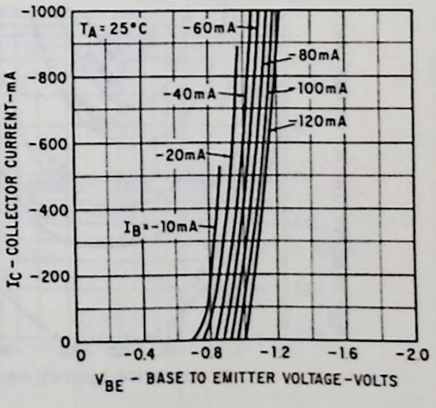
COLLECTOR CHARACTERISTICS*



BASE CHARACTERISTICS*



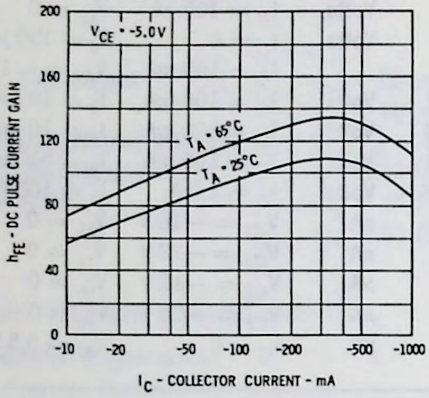
BASE CHARACTERISTICS*



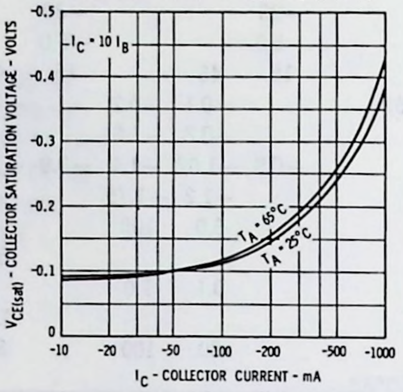
*Single family characteristics on Transistor Curve Tracer

TYPICAL ELECTRICAL CHARACTERISTICS

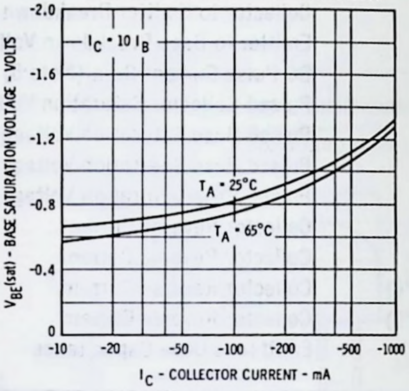
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



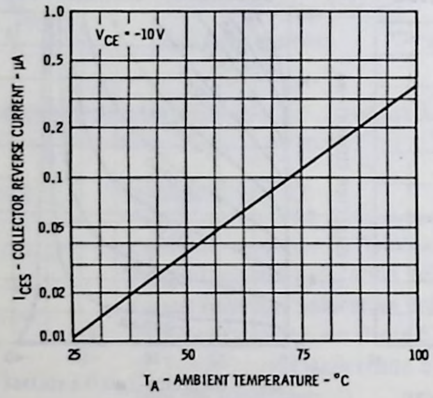
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



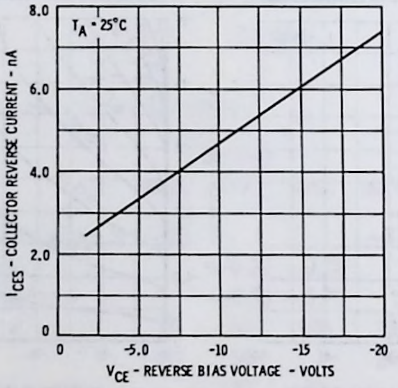
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



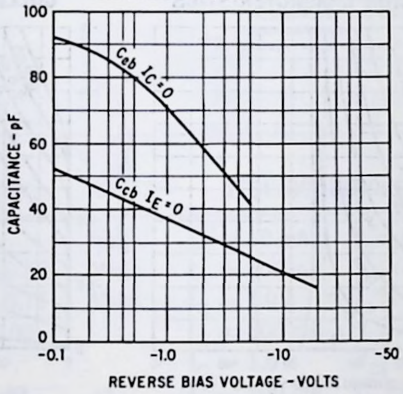
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



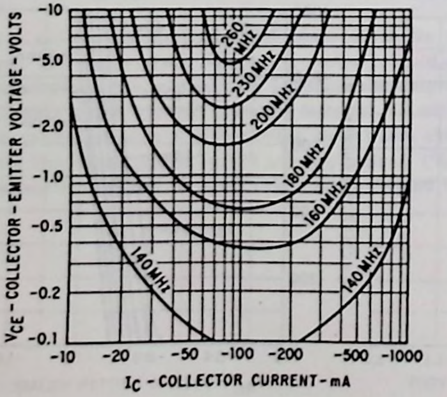
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



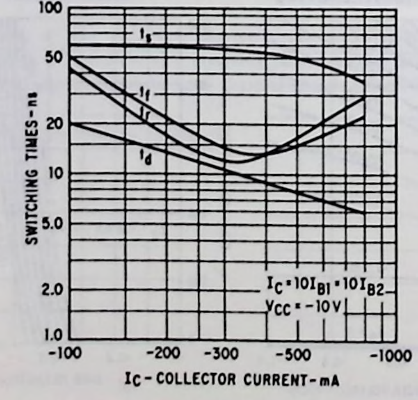
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



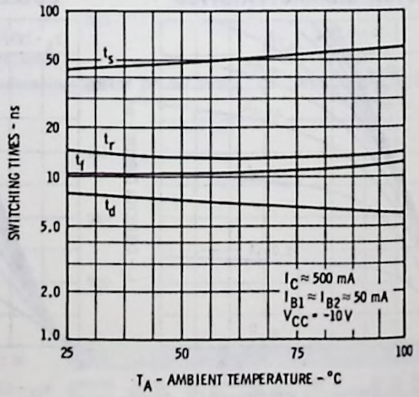
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



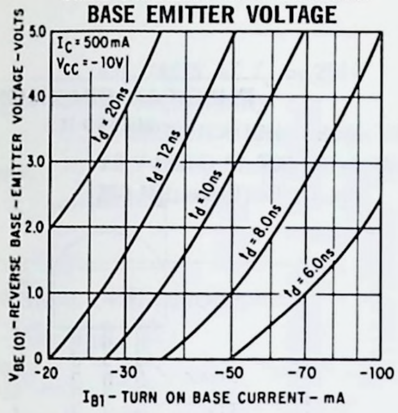
SWITCHING TIMES VERSUS COLLECTOR CURRENT



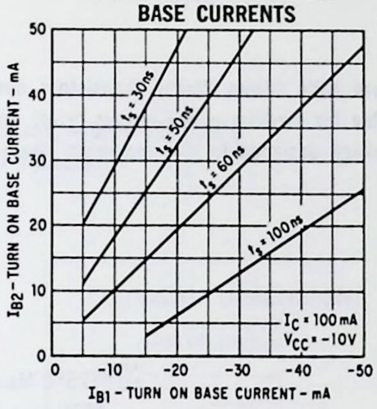
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



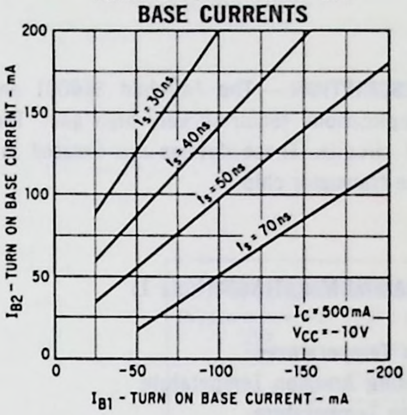
TYPICAL ELECTRICAL CHARACTERISTICS



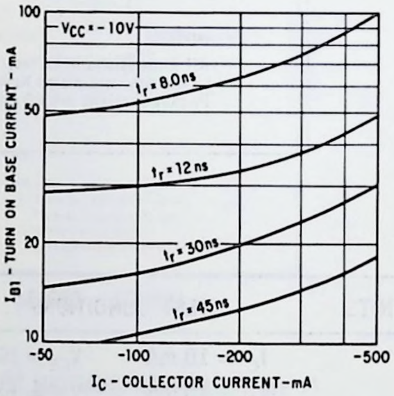
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



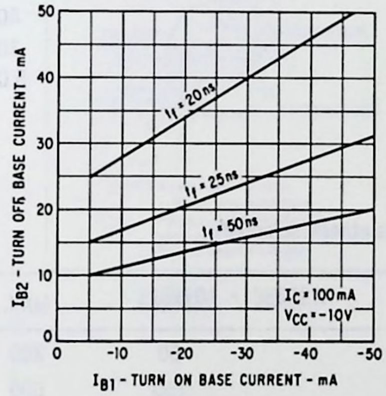
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



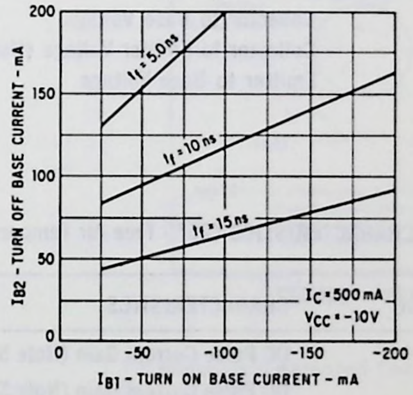
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



RISE TIME VERSUS COLLECTOR CURRENT AND TURN-ON BASE CURRENTS

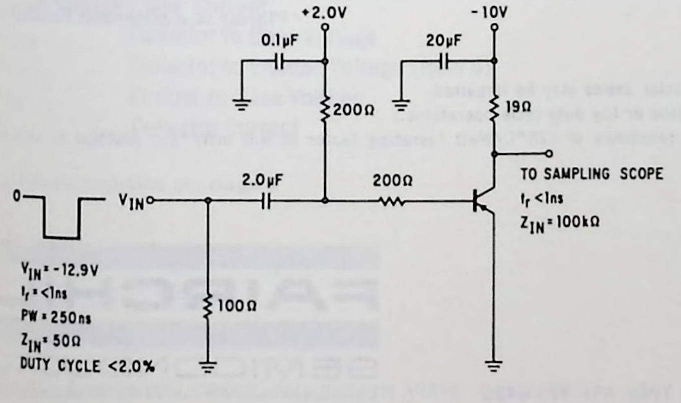


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



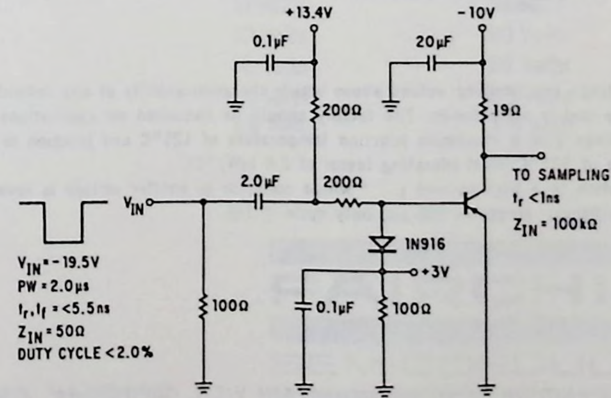
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

TURN-ON CIRCUIT



+2.0V
-10V
0.1µF
20µF
200Ω
19Ω
0
VIN
2.0µF
200Ω
TO SAMPLING SCOPE
tr < 1ns
ZIN = 100kΩ
100Ω
VIN = -12.9V
tr = <1ns
PW = 250ns
ZIN = 50Ω
DUTY CYCLE <2.0%

TURN-OFF CIRCUIT



+13.4V
-10V
0.1µF
20µF
200Ω
19Ω
VIN
2.0µF
200Ω
TO SAMPLING SCOPE
tr < 1ns
ZIN = 100kΩ
1N916
+3V
100Ω
0.1µF
100Ω
VIN = -19.5V
PW = 2.0µs
tr, tf = <5.5ns
ZIN = 50Ω
DUTY CYCLE < 2.0%

SE6001 • SE6002

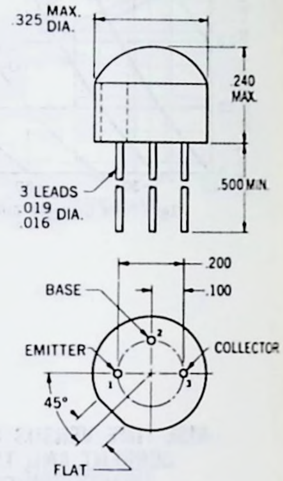
NPN HIGH GAIN TYPE

DIFFUSED SILICON PLANAR* TRANSISTORS

GENERAL DESCRIPTION — The Fairchild SE6001 and SE6002 are NPN Silicon Planar Transistors designed for use in applications requiring very high gain. They are suitable for medium power output driver and low power output circuits. These devices are encased in a solid package designed to give maximum mechanical support to the transistor chip.

PHYSICAL DIMENSIONS

(JEDEC TO-105)



NOTES:
All dimensions in inches.
Leads are gold-plated Kovar.
Package weight is 0.68 gram.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Operating Junction Temperature	125°C Maximum
Storage Temperature	−55°C to +125°C
Lead Temperature (Soldering, 10 second time limit)	260°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	0.8 Watt
at 75°C Case Temperature	0.4 Watt
at 25°C Ambient Temperature	0.3 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5) [SE6001]	50	200		$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5) [SE6002]	150	600		$I_C = 10$ mA	$V_{CE} = 10$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0			$I_C = 30$ mA	$V_{CE} = 10$ V
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		1.0	Volt	$I_C = 100$ mA	$I_B = 10$ mA
$V_{BE(on)}$	Base to Emitter "On" Voltage (Note 5)		0.9	Volt	$I_C = 100$ mA	$V_{CE} = 1.0$ V
I_{CBO}	Collector Cutoff Current		500	nA	$I_E = 0$	$V_{CB} = 20$ V
I_{CBO}(75°C)	Collector Cutoff Current		5.0	μA	$I_E = 0$	$V_{CB} = 20$ V
C_{obo}	Output Capacitance		25	pF	$I_E = 0$	$V_{CB} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	40		Volts	$I_C = 100$ μA	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	30		Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	$I_E = 100$ μA	$I_C = 0$

*Planar is a patented Fairchild proce

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient ther resistance of 333°C/Watt (derating factor of 3.0 mW/°C).
(4) Rating refers to a high-current [illegible] where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle ≤ 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

SE6020 · SE6020A · SE6021 · SE6021A · SE6022 · SE6023

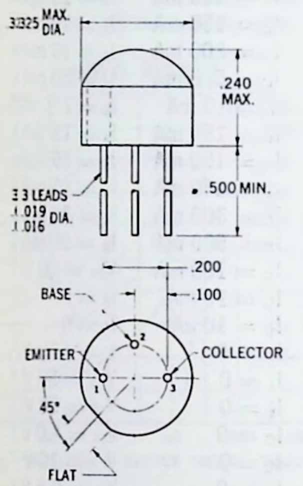
NPN GENERAL PURPOSE AMPLIFIERS AND SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- P_D ..... 4.0 WATTS AT $T_C = 25°C$
- LV_{CEO} ... 80 VOLTS (MIN)
- h_{FE} ..... 12 SPECIFICATIONS FROM 100 μA TO 500 mA; −55°C TO +65°C
- $V_{CE(sat)}$ ... 0.5 V (MAX) AT 500 mA; 0.18 V (MAX) AT 150 mA
- f_T ...... 250 MHz (MIN) AT 50 mA

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-105) outline



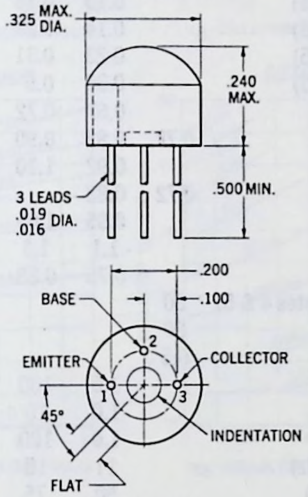
.325 MAX. DIA.
.240 MAX.
3 LEADS .019 .016 DIA.
.500 MIN.
.200
BASE
.100
EMITTER
COLLECTOR
2
1
3
45°
FLAT

NOTES: All dimensions in inches
Leads are gold plated kovar
Package is electrically Non-conductive material
Package weight is 0.66 gram

SE6020 • SE6021

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-105) outline



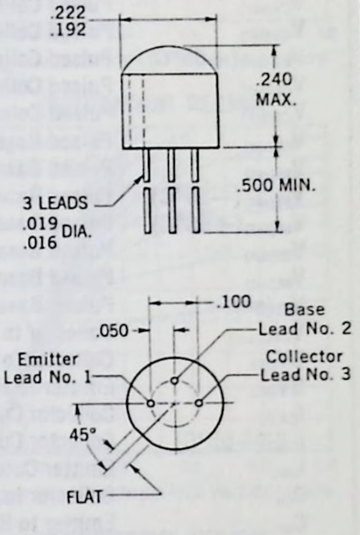
.325 MAX. DIA.
.240 MAX.
3 LEADS .019 .016 DIA.
.500 MIN.
.200
BASE
.100
EMITTER
COLLECTOR
2
1
3
45°
INDENTATION
FLAT

NOTES: All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

SE6020A • SE6021A

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-106) outline



.222 .192
.240 MAX.
3 LEADS .019 .016 DIA.
.500 MIN.
.100
.050
Base Lead No. 2
Emitter Lead No. 1
Collector Lead No. 3
45°
FLAT

NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

SE6022 • SE6023

* Planar is a patented Fairchild process.

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

	SE6020 SE6021	SE6020A SE6021A	SE6022 SE6023
Total Dissipation at 25°C Case Temperature	0.8 Watt	4.0 Watts	0.6 Watt
at 25°C Ambient Temperature	0.3 Watt	0.5 Watt	0.22 Watt

Maximum Voltages and Current

		SE6020 SE6020A SE6022	SE6021 SE6021A SE6023
V_{CBO}	Collector to Base Voltage	60 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts	80 Volts
V_{EBO}	Emitter to Base Voltage	6.5 Volts	6.5 Volts
I_C	Collector Current	1.0 Amp	1.0 Amp

ectrical Characteristics on page 2

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

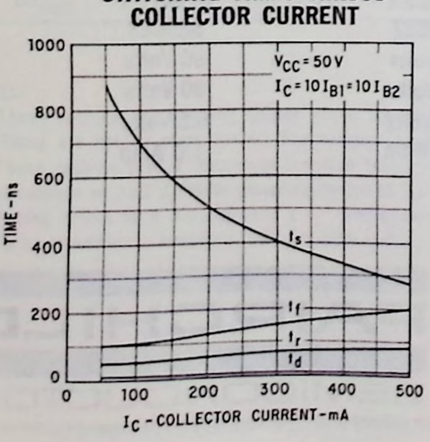
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		SE6020 • SE6020 A • SE6022			SE6021 • SE6021 A • SE6023					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Pulse Current Gain** (Note 5)	**40**	**100**		**40**	**100**			$I_C = 150$ mA	$V_{CE} = 1.0$ V
h_{FE}(−55°C)	**DC Pulse Current Gain** (Note 5)	**10**	**40**		**10**	**40**			$I_C = 150$ mA	$V_{CE} = 1.0$ V
h_{FE}(+65°C)	DC Pulse Current Gain (Note 5)		120	340		120	340		$I_C = 150$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Current Gain	30	60		30	70			$I_C = 100\ \mu$A	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	60	100		60	120			$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	90	140		90	170			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	100	150		100	180			$I_C = 50$ mA	$V_{CE} = 10$ V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**100**	**180**	**300**	**100**	**180**	**300**		$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	25	60		25	60			$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}(+65°C)	**DC Pulse Current Gain** (Note 5)		**220**	**380**		**220**	**380**		$I_C = 150$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	70	100		70	120			$I_C = 300$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	45	60		45	70			$I_C = 500$ mA	$V_{CE} = 10$ V
h_{fe}	**High Frequency Current Gain (f = 100 MHz)**	**2.5**	**4.0**	**6.0**	**2.5**	**4.0**	**6.0**		$I_C = 50$ mA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.04	0.07		0.04	0.07	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)		**0.15**	**0.18**		**0.15**	**0.18**	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{CE(sat)}$(+65°C)	Pulsed Collector Saturation Voltage (Note 5)		0.14	0.28		0.14	0.28	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.23	0.31		0.27	0.31	Volts	$I_C = 300$ mA	$I_B = 30$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.36	0.5		0.42	0.5	Volts	$I_C = 500$ mA	$I_B = 50$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.67	0.72		0.67	0.72	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)	**0.78**	**0.82**	**0.90**	**0.78**	**0.82**	**0.90**	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(sat)}$(−55°C)	**Pulsed Base Saturation Voltage** (Note 5)		**0.92**	**1.10**		**0.92**	**1.10**	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(sat)}$(+65°C)	**Pulsed Base Saturation Voltage** (Note 5)	**0.72**	**0.82**		**0.72**	**0.82**		Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)		**0.95**	**1.05**		**0.95**	**1.05**	Volts	$I_C = 300$ mA	$I_B = 30$ mA
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)		**1.1**	**1.3**		**1.1**	**1.3**	Volts	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE}(on)	Pulsed Base Emitter On Voltage		0.75	0.88		0.75	0.88	Volts	$I_C = 150$ mA	$V_{CE} = 10$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	60			80			Volts	$I_C = 10$ mA	$I_B = 0$
BV_{CES}	Collector to Base Breakdown Voltage	60			80			Volts	$I_C = 10\ \mu$A	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.5			6.5			Volts	$I_C = 0$	$I_E = 10\ \mu$A
I_{CBO}	Collector Cutoff Current		1.0	100		1.0	100	nA	$I_E = 0$	$V_{CB} = 50$ V
I_{CBO}(+65°C)	Collector Cutoff Current		1.0	10		1.0	10	μA	$I_E = 0$	$V_{CB} = 50$ V
I_{EBO}	Emitter Cutoff Current		1.0	100		1.0	100	nA	$I_C = 0$	$V_{EB} = 4.0$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		11	15		11	15	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		50	75		50	75	pF	$I_C = 0$	$V_{EB} = 0.5$ V
t_{on}	Turn On Time (Fig. 1)		70	150		70	150	ns	$I_C \approx 150$ mA	$I_{B1} \approx 15$ mA
t_{off}	Turn Off Time (Fig. 1)		700	1000		700	1000	ns	$I_C \approx 150$ mA	$I_{B1} \approx 15$ mA $I_{B2} \approx -15$ mA
t_{on}	Turn On Time (Fig. 1)		80			80		ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA
t_{off}	Turn Off Time (Fig. 1)		600			600		ns	$I_C \approx 300$ mA	$I_{B1} \approx 30$ mA $I_{B2} \approx -30$ mA
t_{on}	Turn On Time (Fig. 1)		100			100		ns	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA
t_{off}	Turn Off Time (Fig. 1)		500			500		ns	$I_C \approx 500$ mA	$I_{B1} \approx 50$ mA $I_{B2} \approx -50$ mA

t_{on}, t_{off} TEST CIRCUIT

SWITCHING TIMES VERSUS COLLECTOR CURRENT



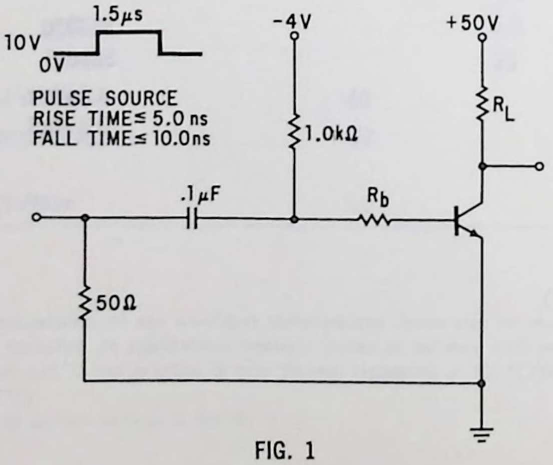
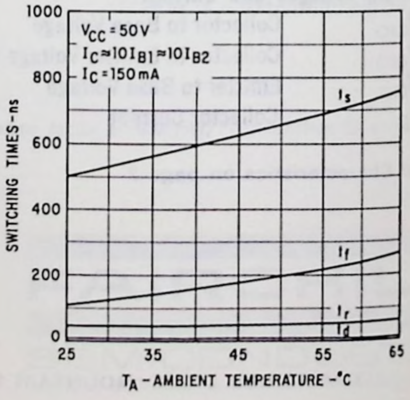


FIG. 1

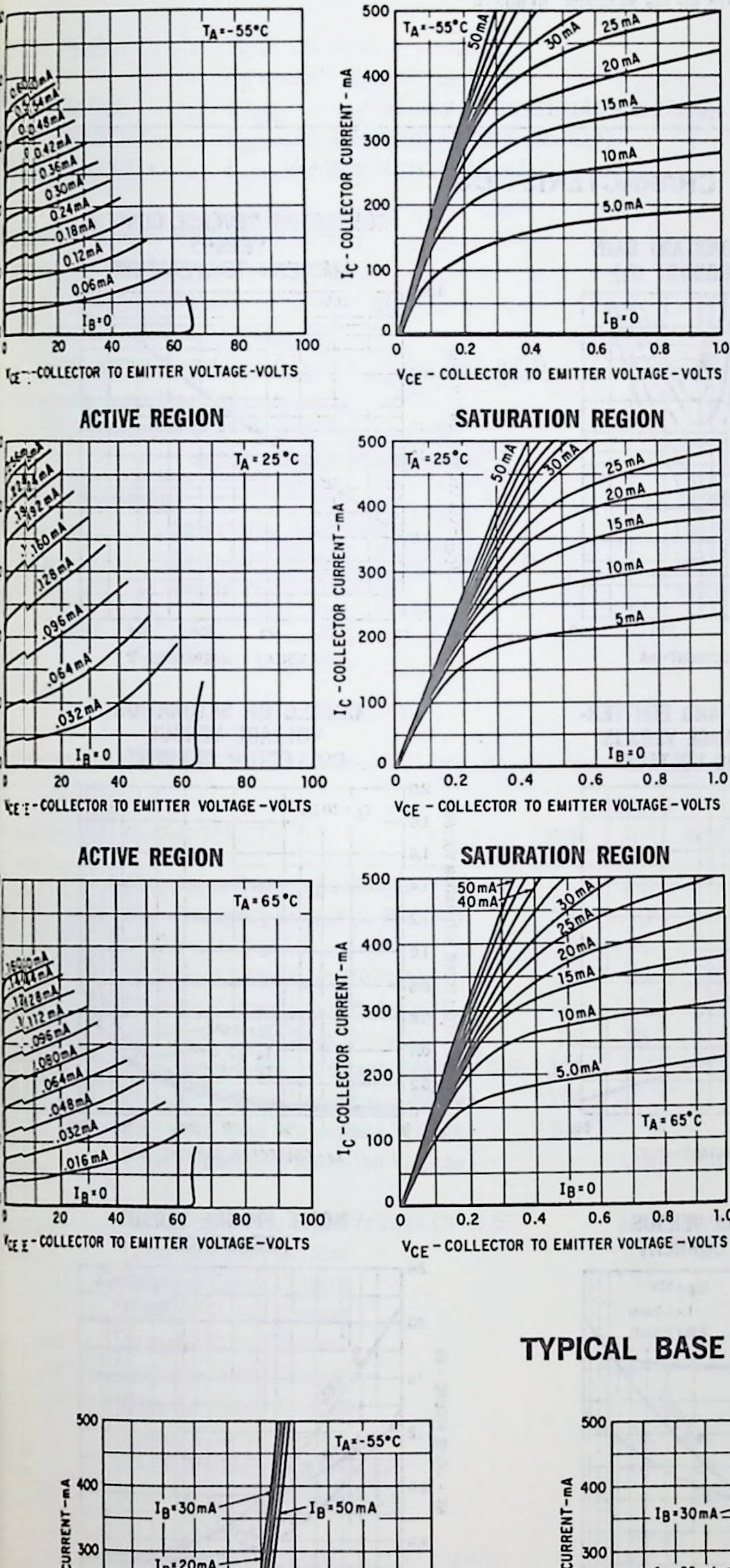
I_C	R_b	R_L
150 mA	314 Ω	330 Ω
300 mA	157 Ω	167 Ω
500 mA	94 Ω	100 Ω

SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



TYPICAL COLLECTOR CHARACTERISTICS*

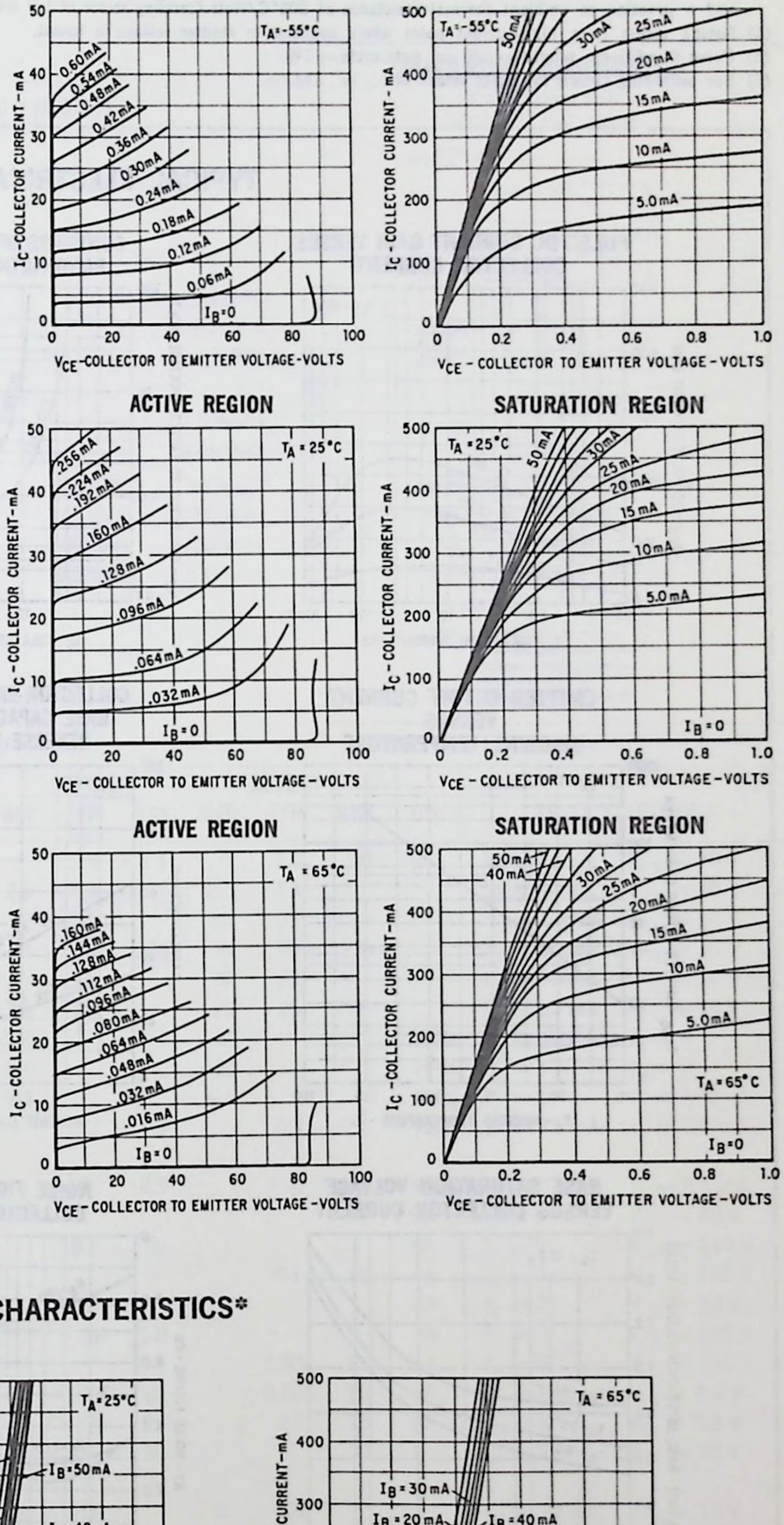
SE6020 • SE6020A • SE6022



ACTIVE REGION

SATURATION REGION

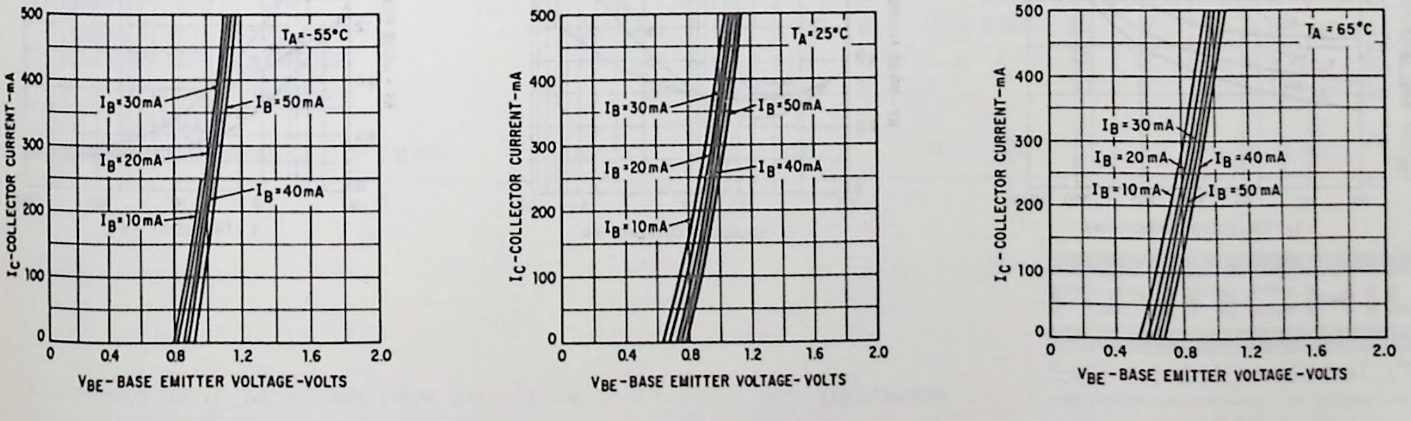
SE6021 • SE6021A • SE6023



ACTIVE REGION

SATURATION REGION

TYPICAL BASE CHARACTERISTICS*



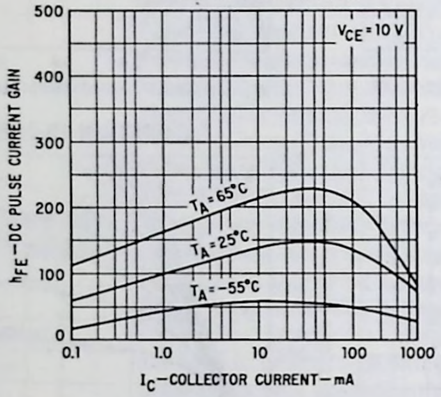
* Single family characteristic on Transistor Curve Tracer.

NOTES:

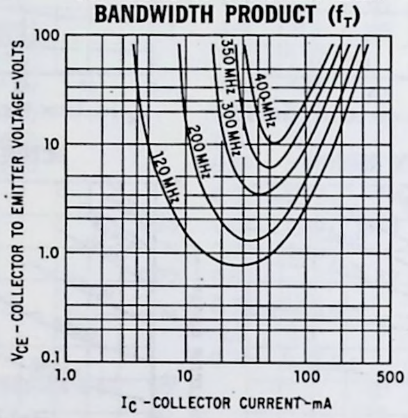
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C) for the SE6020, SE602 and 333°C/Watt (derating factor of 3.0 mW/°C) for the SE6022 and SE6023. Junction to ambient thermal resistance of 167°C/Watt (derating factor of 6.0 mW/°C) for th SE6020, SE6021 and 455°C/Watt (derating factor of 2.2 mW/°C) for the SE6022 and SE6023. Junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C and a junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C) for the SE6020A, SE6021A.
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

TYPICAL ELECTRICAL CHARACTERISTICS

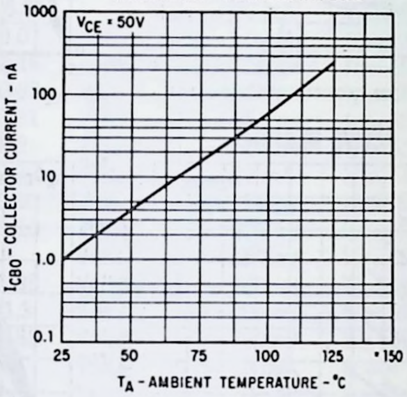
PULSE DC CURRENT GAIN VERSUS COLLECTOR CURRENT



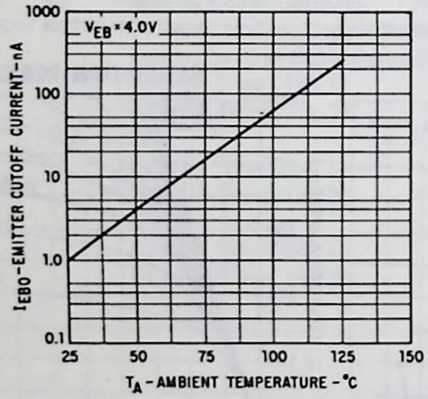
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



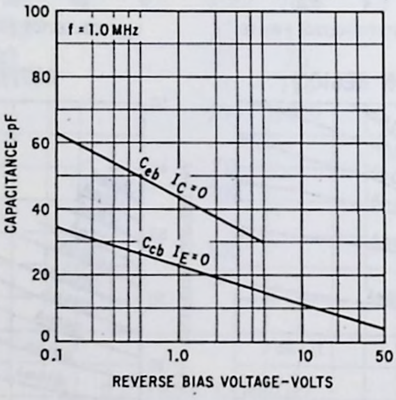
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



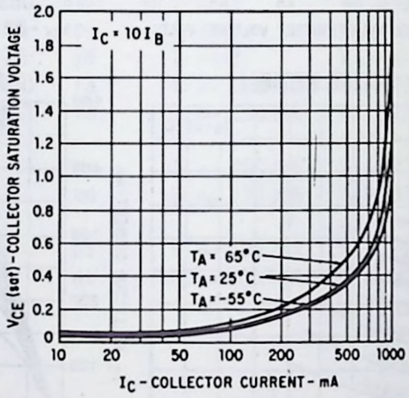
EMITTER CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



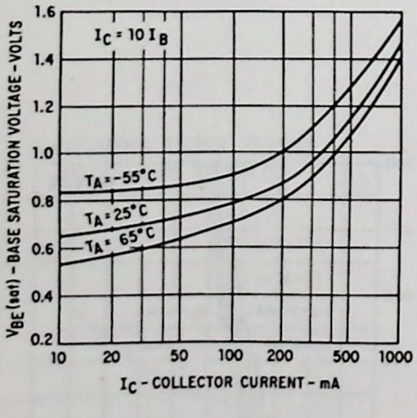
COLLECTOR-BASE AND EMITTER-BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



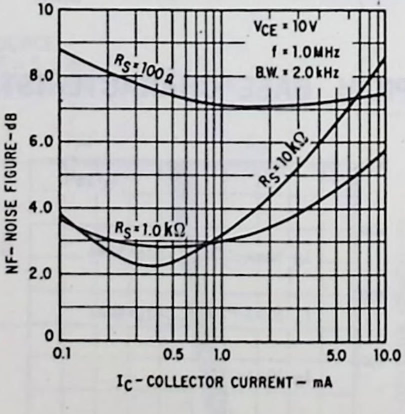
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



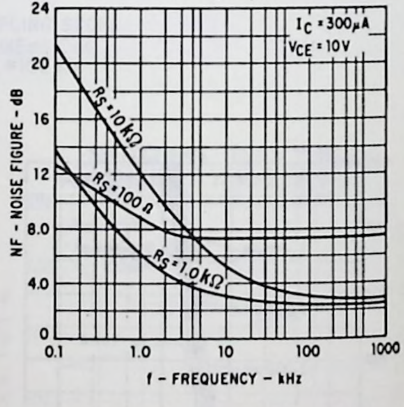
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



NOISE FIGURE VERSUS COLLECTOR CURRENT



NOISE FIGURE VERSUS FREQUENCY



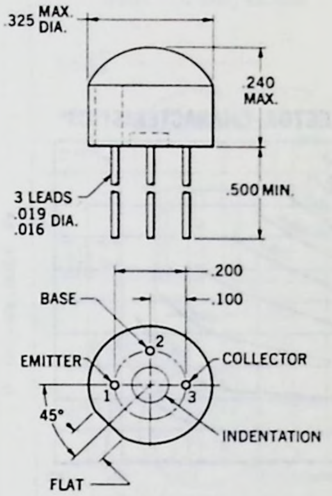
SE7015 • SE7016 • SE7017

NPN HIGH VOLTAGE AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

HIGH POWER . . . . . . $P_D = 3.0$ **W AT** $T_C = 25°C$
$P_D = 0.45$ **W AT** $T_A = 25°C$
HIGH VOLTAGE . . . . . LV_{CEO} **= (MIN) 100 V (SE7015); 140 V (SE7016); 180 V (SE7017)**
LOW CAPACITANCE . . . C_{cb} **= 3.0 pF (MAX) AT 20 V (SE7017)**
HIGH FREQUENCY . . . f_T **= 50 MHz (MIN) AT 10 mA**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES All dimensions in inches
Leads are gold-plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

SOLUTE MAXIMUM RATINGS (Note 1)

		SE7015	SE7016	SE7017
Maximum Temperature				
Storage Temperature				−55°C to +125°C
Operating Junction Temperature				+125°C
Lead Temperature (Soldering, 10 second time limit)				+260°C
Maximum Power Dissipation (Notes 2 and 3)				
Total Dissipation at 25°C Case Temperature				**3.0 Watts**
at 25°C Ambient Temperature				**0.45 Watt**
Maximum Voltages				
V_{CBO}	Collector to Base Voltage	100 Volts	140 Volts	180 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	100 Volts	140 Volts	180 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts	6.0 Volts

*Planar is a patented Fairchild process.

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		SE7015			SE7016			SE7017					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
C_{cb}	**Collector to Base Capacitance**		2.8	3.5		2.8	3.5		2.4	3.0	pF	$I_E = 0$	$V_{CB} = 20$ V
h_{fe}	**High Frequency Gain (f = 20 MHz)**	**2.5**	**4.3**		**2.5**	**4.3**		**2.5**	**4.3**			$I_C = 10$ mA	$V_{CE} = 10$ V
h_{FE}	DC Current Gain	30	75		30	75		30	75			$I_C = 1.0$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	50	90	275	50	90	275	50	90	275		$I_C = 25$ mA	$V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	30	75		30	75		30	75			$I_C = 50$ mA	$V_{CE} = 10$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	15	25		15	25		15	25			$I_C = 25$ mA	$V_{CE} = 10$ V
$V_{CEO(sus)}$	**Collector to Emitter Voltage** (Notes 4 & 5)	**100**			**140**			**180**			**Volts**	$I_C = 10$ mA	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	100			140			180			Volts	$I_C = 100$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			6.0			Volts	$I_C = 0$	$I_E = 100$ μA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage		0.3	2.0		0.3	2.0		0.3	2.0	Volts	$I_C = 25$ mA	$I_B = 2.5$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.77	0.9		0.77	0.9		0.77	0.9	Volts	$I_C = 25$ mA	$I_B = 2.5$ mA
I_{CBO}	Collector Cutoff Current		0.1	10							nA	$I_E = 0$	$V_{CB} = 80$ V
I_{CBO}	Collector Cutoff Current					0.1	10				nA	$I_E = 0$	$V_{CB} = 110$ V
I_{CBO}	Collector Cutoff Current								0.1	10	nA	$I_E = 0$	$V_{CB} = 150$ V
I_{CBO}(65°C)	Collector Cutoff Current		0.001	1.0							μA	$I_E = 0$	$V_{CB} = 80$ V
I_{CBO}(65°C)	Collector Cutoff Current					0.001	1.0				μA	$I_E = 0$	$V_{CB} = 110$ V
I_{CBO}(65°C)	Collector Cutoff Current								0.001	1.0	μA	$I_E = 0$	$V_{CB} = 150$ V
I_{EBO}	Emitter Cutoff Current		0.005	10		0.005	10		0.005	10	nA	$I_C = 0$	$V_{EB} = 4.0$ V
C_{eb}	Emitter to Base Capacitance		17	25		17	25		17	25	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$R_e(h_{ie})$	Real Part of Input Impedance (f = 300 MHz)			50			50			50	Ω	$I_C = 10$ mA	$V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	40	100		40	100		40	100			$I_C = 25$ mA	$V_{CE} = 10$ V

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SEMICONDUCTOR
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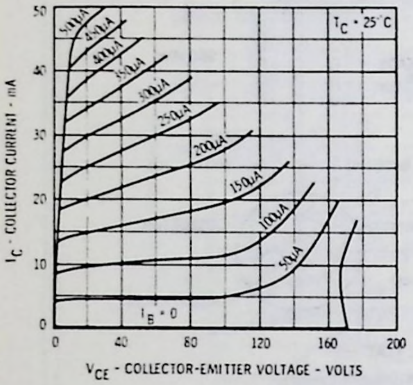
NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 33.3°C/Watt (derating factor of 30 mW/°C); junction to ambient thermal resistance of 222°C/Watt (derating factor of 4.5 mW/°C).
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

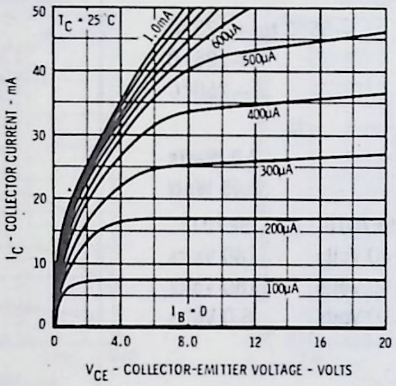
TYPICAL ELECTRICAL CHARACTERISTICS (SE7016 ONLY)

(Except Safe Operating Area, which is a guarantee)

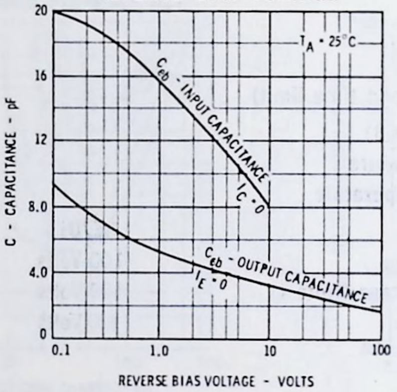
COLLECTOR CHARACTERISTICS*



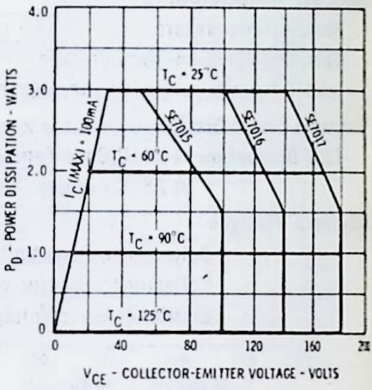
COLLECTOR CHARACTERISTICS*



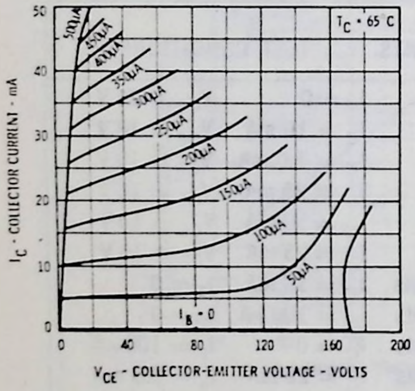
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



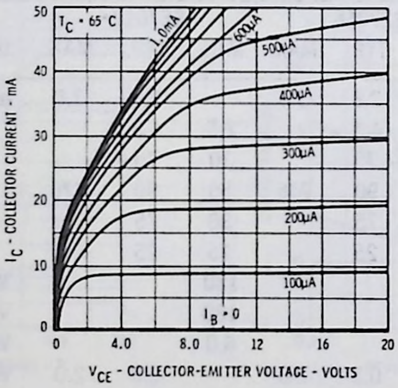
GUARANTEED MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE



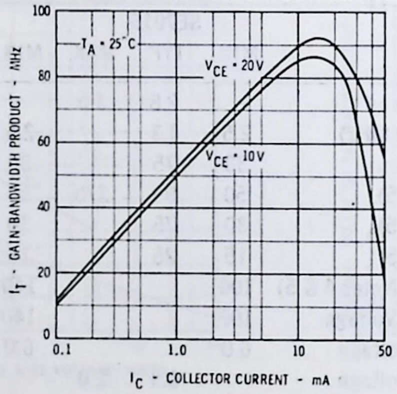
COLLECTOR CHARACTERISTICS*



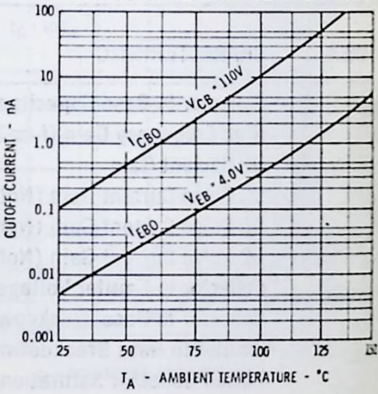
COLLECTOR CHARACTERISTICS*



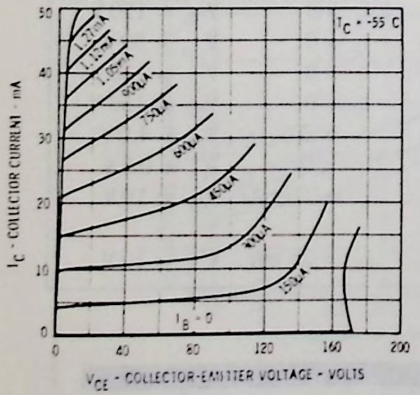
GAIN—BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



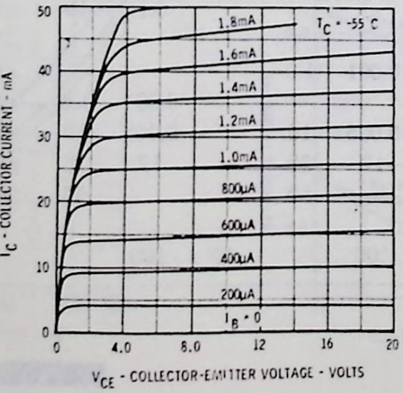
COLLECTOR & EMITTER CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



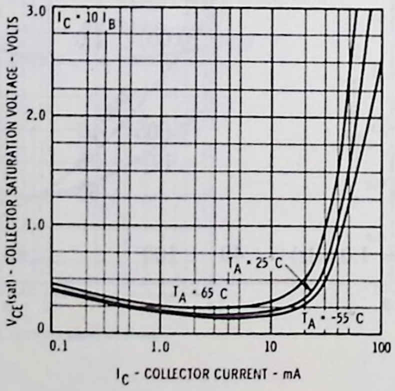
COLLECTOR CHARACTERISTICS*



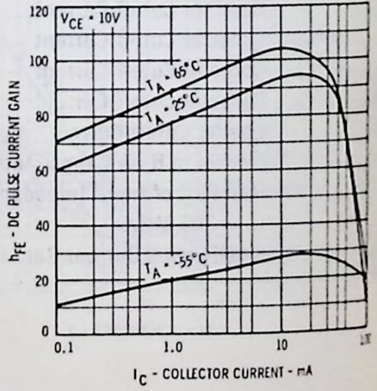
COLLECTOR CHARACTERISTICS*



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



* Single Family Characteristics on Transistor Curve Tracer.

SE8010 · SE8012
NPN RF AMPLIFIER
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

HIGH POWER DISSIPATION . . . P_D = 800 mW AT T_A = 25°C
P_D = 4.0 W AT T_C = 25°C
HIGH POWER GAIN . . . . 600 mW P_O AT 27 MHz
HIGH VOLTAGE . . . . LV_{CEO} = 60 V

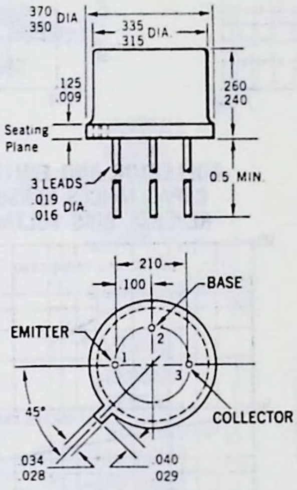
BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	**SE8010**	**SE8012**
Storage Temperature	−65°C to +200°C	−65°C to +125°C
Operating Junction Temperature	200°C Maximum	125°C Maximum

Maximum Power Dissipation (Notes 2 and 3)	**SE8010**	**SE8012**
Total Dissipation at 25°C Case Temperature	**4.0 W**	**4.0 W**
at 25°C Free Air Temperature	**800 mW**	**500 mW**

Maximum Voltages and Current		**SE8010**	**SE8012**
V_{CBO}	Collector to Base Voltage	100 Volts	100 Volts
V_{CEO}	**Collector to Emitter Voltage** (Note 4)	**60 Volts**	**60 Volts**
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	Collector Current	500 mA	500 mA

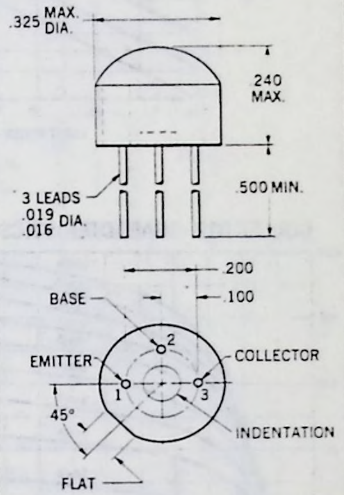
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 1.23 gram

SE8010

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-105) outline



NOTES: All dimensions in inches
Leads are gold plated nickel
Package is electrically Non conductive material
Package weight is 0.66 gram

SE8012

*Planar is a patented Fairchild process.

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
G_{PE}	**Amplifier Power Gain (f = 27 MHz)** (Note 6)	**10.8**	**12**		**dB**	**V_{CE} = 12 V**	**P_{in} = 50 mW**
h_{FE}	DC Pulse Current Gain (Note 5)	40		150		I_C = 100 mA	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	15				I_C = 500 mA	V_{CE} = 3.0 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0				I_C = 50 mA	V_{CE} = 10 V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)			0.75	Volts	I_C = 500 mA	I_B = 50 mA
$V_{BE(sat)}$	Pulsed Emitter Saturation Voltage (Note 5)			1.20	Volts	I_C = 500 mA	I_B = 50 mA
I_{CES}	Collector Reverse Current			500	nA	V_{CE} = 50 V	V_{EB} = 0
C_{cb}	Collector-Base Capacitance			9.0	pF	V_{CB} = 10 V	I_E = 0
C_{eb}	Emitter-Base Capacitance			65	pF	V_{EB} = 0.5 V	I_C = 0
BV_{CBO}	Collector to Base Breakdown Voltage	100			Volts	I_C = 100 μA	I_E = 0
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Note 5)	**60**			**Volts**	**I_C = 10 mA**	**I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			Volts	I_E = 100μA	I_C = 0

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 200°C, a junction to case thermal resistance of 43.8°C/Watt (derating factor of 22.8 mW/°C) and a junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the SE8010. These ratings give a maximum junction temperature of 125°C, a junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C) and a junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C) for the SE8012.

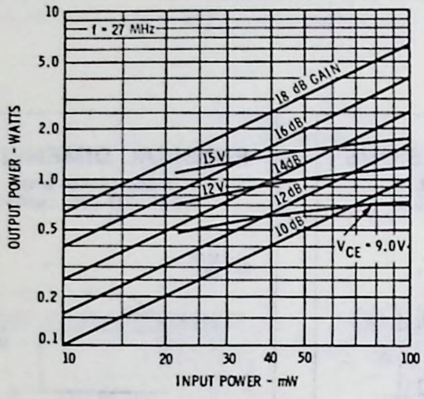
Rating refers to a high-current point where collector to emitter voltage is lowest.

Pulse Conditions: length = 300 μs; duty cycle = 1%.

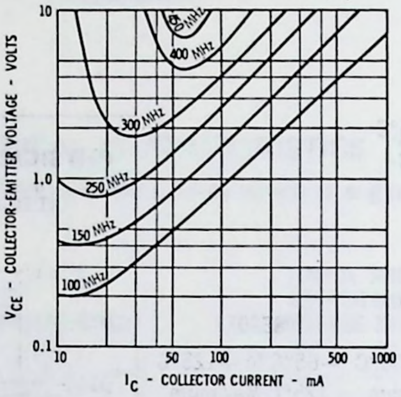
See Test Circuit.

TYPICAL ELECTRICAL CHARACTERISTICS

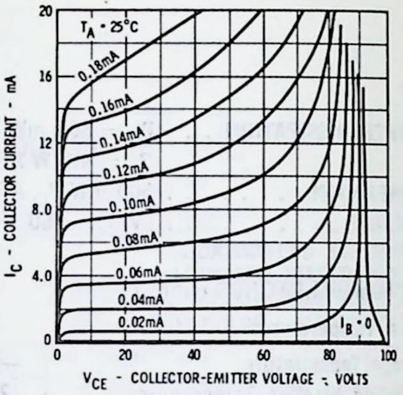
TYPICAL DRIVER AMPLIFIER PERFORMANCE



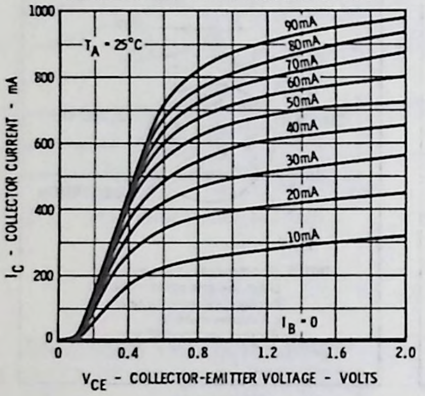
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



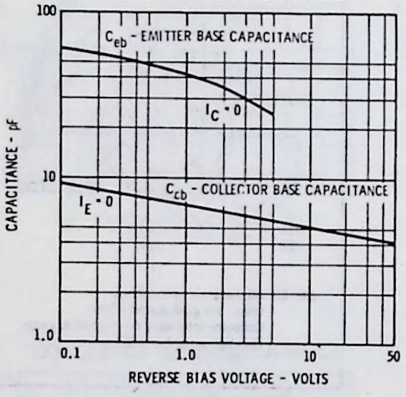
COLLECTOR CHARACTERISTICS*



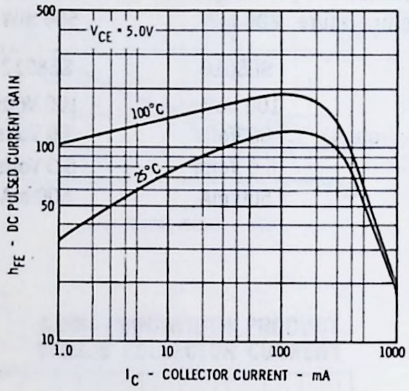
COLLECTOR CHARACTERISTICS*



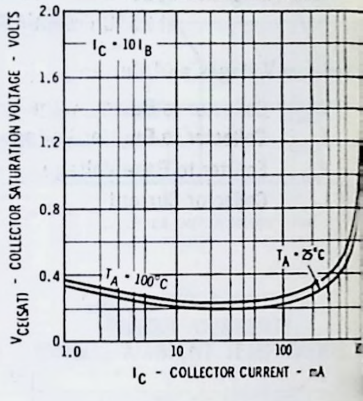
COLLECTOR AND EMITTER CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT

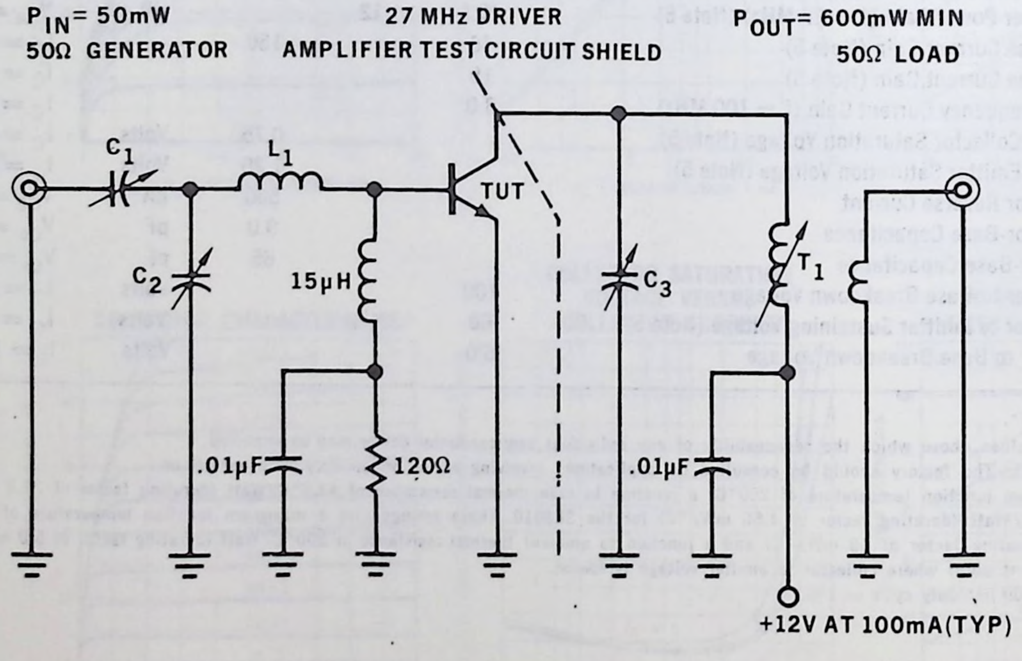


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



*Single family characteristic on Transistor Curve Tracer.

27 MHz DRIVER AMPLIFIER TEST CIRCUIT SHIELD


P_{IN} = 50mW
50Ω GENERATOR
P_{OUT} = 600mW MIN
50Ω LOAD
C_1
L_1
C_2
15μH
TUT
C_3
T_1
.01μF
120Ω
.01μF
+12V AT 100mA(TYP)

C₁, C₂ — 7 to 100pF, compression mica trimmer (Arco 423)
C₃ — 43 to 63pF, compression mica trimmer (Arco 402) in parallel with 43pF. Dipped mica.
L₁ — 0.35μH (7 T Air Dux 408)
T₁ — 9 turns primary, 5 turns secondary
No. 18 enamel close wound on ¼ inch slug tuned form
(CTC 1535-2-2, red slug).

SE8040 · SE8041 · SE8042 · SE8540 · SE8541 · SE8542

NPN-PNP GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

MATCHED h_{FE} GROUPINGS AVAILABLE (See Note 7)

HIGH GAIN	**h_{FE} = 40-540 AT 150 mA, 1.0 V** **h_{FE} = 30 (MIN) AT 500 mA, 1.0 V**
NPN AND PNP COMPLEMENTS (Note 7)	**SE8040, SE8041 AND SE8042 ARE NPN** **SE8540, SE8541 AND SE8542 ARE PNP**
LOW SATURATION VOLTAGE	**$V_{CE(sat)}$ = 0.12 V (MAX) AT 150 mA, 0.3 V (MAX) AT 500 mA FOR SE8040, SE8041 AND SE8042** **$V_{CE(sat)}$ = —0.25 V (MAX) AT 150 mA, —0.7 V (MAX) AT 500 mA FOR SE8540, SE8541 AND SE8542**

BSOLUTE MAXIMUM RATINGS (Note 1)

	SE8040 SE8540	SE8041 SE8541	SE8042 SE8542
Maximum Temperatures			
Storage Temperature	—55°C to +125°C	—65°C to +200°C	—65°C to +200°C
Operating Junction Temperature	+125°C	+200°C	+200°C
Lead Temperature (Soldering, 10 second time limit)	+260°C	+300°C	+300°C
Maximum Power Dissipation (Notes 2, 3 and 4)			
Total Dissipation at or below 100°C Case Temperature			4.0 Watts
Total Dissipation at 25°C Case Temperature	4.0 Watts	4.0 Watts	
at 25°C Free Air Temperature	0.5 Watt	0.8 Watt	1.0 Watt

		SE8040 SE8041 SE8042	SE8540 SE8541 SE8542
Maximum Voltages and Current			
V_{CBO}	Collector to Base Voltage	30 Volts	—30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 5)	30 Volts	—30 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	—5.0 Volts
I_C	Continuous Collector Current ($T_C = +75°C$)	1.0 Amp	1.0 Amp
I_C	Continuous Collector Current ($T_C = +100°C$)	0.75 Amp	0.75 Amp

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

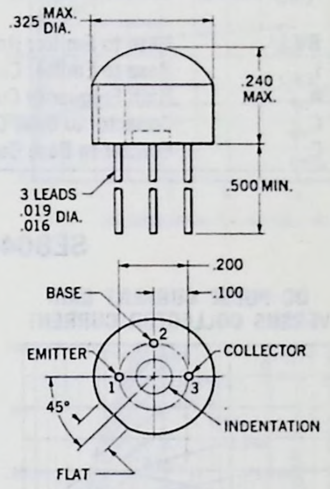
MBOL	CHARACTERISTICS		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS (Reverse Voltage Polarity For PNP)
	DC Pulse Current Gain (Note 6)		**40**	**70**	**540**		**$I_C = 150$ mA $V_{CE} = 1.0$ V**
	DC Pulse Current Gain (Note 6)		**30**	**65**			**$I_C = 500$ mA $V_{CE} = 1.0$ V**
EO(sus)	Collector to Emitter Sustaining Voltage (Notes 5 & 6)	SE8040 SE8041, SE8042	30			Volts	$I_C = 30$ mA $I_B = 0$
EO(sus)	Collector to Emitter Sustaining Voltage (Notes 5 & 6)	SE8540 SE8541, SE8042	—30			Volts	$I_C = 30$ mA $I_B = 0$
CBO	Collector to Base Breakdown Voltage	SE8040 SE8041, SE8042	30			Volts	$I_C = 10\ \mu$A $I_E = 0$
CBO	Collector to Base Breakdown Voltage	SE8540 SE8541, SE8542	—30			Volts	$I_C = 100\ \mu$A $I_E = 0$
E(sat)	Pulsed Collector Saturation Voltage (Note 6)	SE8040 SE8041, SE8042		0.35	1.0	Volts	$I_C = 1.0$ A $I_B = 33$ mA
E(sat)	Pulsed Collector Saturation Voltage (Note 6)	SE8540 SE8541, SE8542		—0.5	—1.3	Volts	$I_C = 1.0$ A $I_B = 33$ mA
E(sat)	**Pulsed Collector Saturation Voltage** (Note 6)	**SE8040 SE8041, SE8042**		**0.2**	**0.3**	**Volts**	**$I_C = 500$ mA $I_B = 25$ mA**
E(sat)	**Pulsed Collector Saturation Voltage** (Note 6)	**SE8540 SE8541, SE8542**		**—0.3**	**—0.7**	**Volts**	**$I_C = 500$ mA $I_B = 25$ mA**
E(sat)	**Pulsed Collector Saturation Voltage** (Note 6)	**SE8040 SE8041, SE8042**		**0.08**	**0.12**	**Volts**	**$I_C = 150$ mA $I_B = 15$ mA**
E(sat)	**Pulsed Collector Saturation Voltage** (Note 6)	**SE8540 SE8541, SE8542**		**—0.15**	**—0.25**	**Volts**	**$I_C = 150$ mA $I_B = 15$ mA**

itional Electrical Characteristics on Page 2

Notes on Page 6

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-105) outline

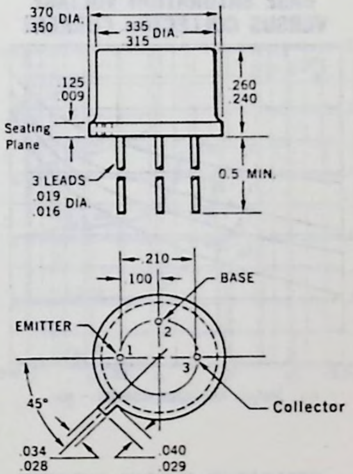


NOTES: All dimensions in inches
Leads are gold plated nickel
Package is electrically Non-conductive material
Package weight is 0.66 gram

SE8040 • SE8540

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 1.23 grams

SE8041 • SE8541
SE8042 • SE8542

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

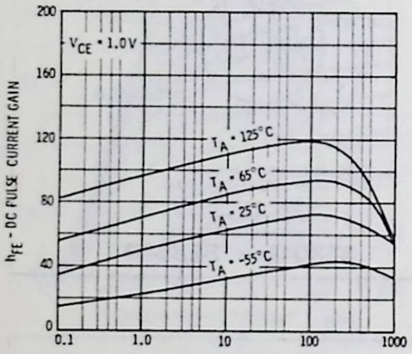
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	SE8040 • SE8041 • SE8042 MIN.	TYP.	MAX.	SE8540 • SE8541 • SE8542 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS (Reverse Voltage Polarity F SE8540 • SE8541 • SE854	
h_{FE}	DC Pulse Current Gain (Note 6)	30	60		30	68			$I_C = 10$ mA	$V_{CE} = 1.0$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)		0.95	1.2		−0.96	−1.2	Volts	$I_C = 1.0$ A	$I_B = 33$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)		0.93	1.0		−0.92	−1.15	Volts	$I_C = 500$ mA	$I_B = 25$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)		0.82	0.85		−0.79	−1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
$V_{BE(on)}$	Pulsed Base Emitter (On) Voltage (Note 6)	0.63	0.68	0.73	−0.65	−0.68	−0.75	Volts	$I_C = 20$ mA	$V_{CE} = 5.0$
I_{CBO}	Collector Cutoff Current		0.9	50		0.1	50	nA	$I_E = 0$	$V_{CB} = 25$
I_{CBO}(65°C)	Collector Cutoff Current	(SE8040)	.008	5.0	(SE8540)	.002	1.0	μA	$I_E = 0$	$V_{CB} = 25$
I_{CBO}(125°C)	Collector Cutoff Current	(SE8041, SE8042)	0.1	20	(SE8541, SE8542)	0.1	20	μA	$I_E = 0$	$V_{CB} = 25$
BV_{EBO}	Base to Emitter Breakdown Voltage	6.0			−5.0			Volts	$I_E = 10$ μA	$I_C = 0$
I_{EBO}	Base to Emitter Cutoff Current		2.0	50		2.0	50	nA	$I_C = 0$	$V_{EB} = 4.0$
h_{fe}	High Frequency Current Gain (f = 100 MHz)	1.3	2.3	5.0	1.0	2.0	5.0		$I_C = 50$ mA	$V_{CE} = 10$
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		9.0	12		20	35	pF	$I_E = 0$	$V_{CB} = 10$
C_{eb}	Emitter to Base Capacitance (f = 1.0 MHz)		60	65		80	120	pF	$I_C = 0$	$V_{EB} = 0.5$

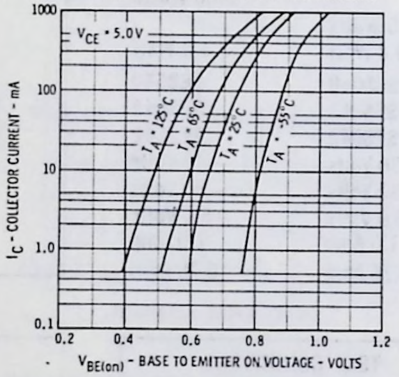
TYPICAL ELECTRICAL CHARACTERISTICS

SE8040 • SE8041 • SE8042

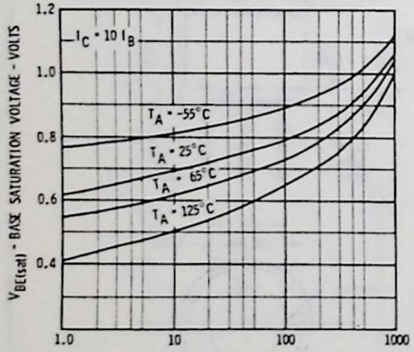
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



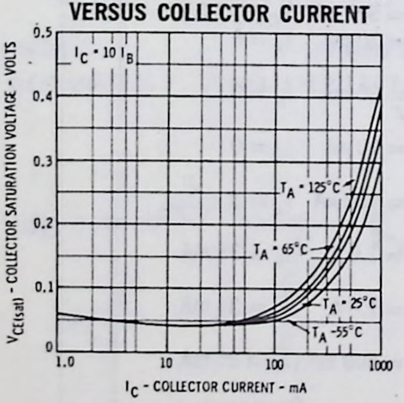
BASE TO EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



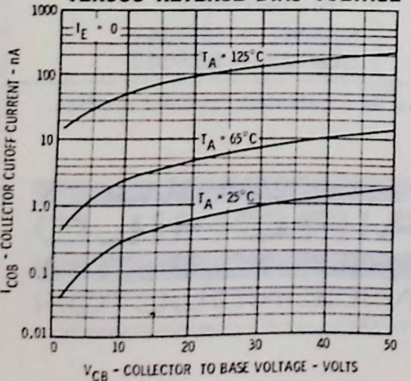
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



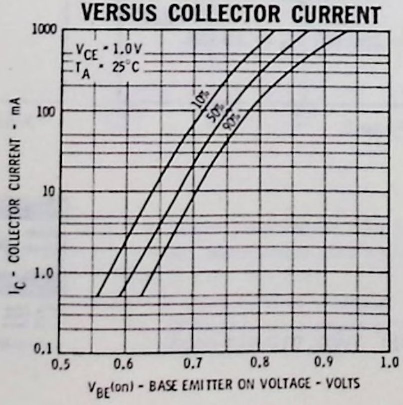
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE

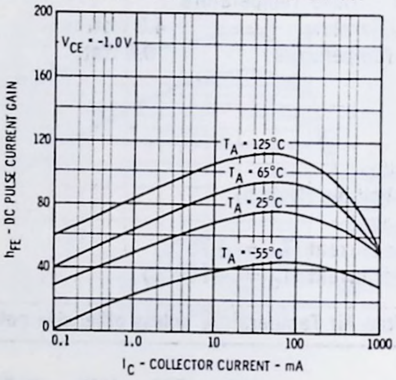


DISTRIBUTION OF BASE EMITTER VOLTAGE VERSUS COLLECTOR CURRENT

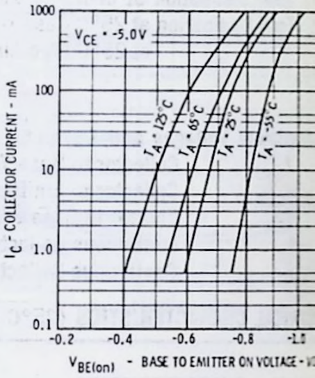


SE8540 • SE8541 • SE8542

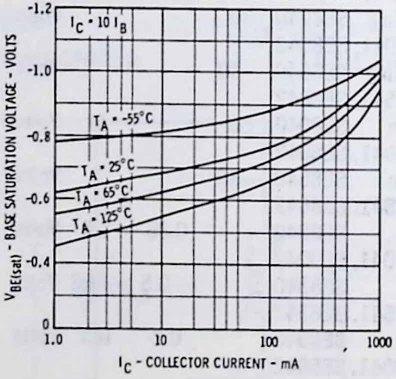
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



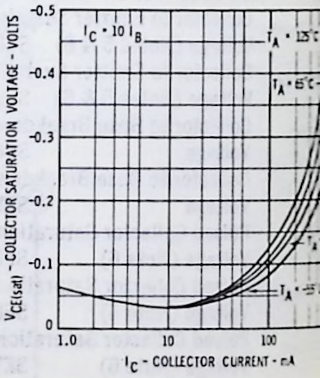
BASE TO EMITTER ON VOLT VERSUS COLLECTOR CURRE



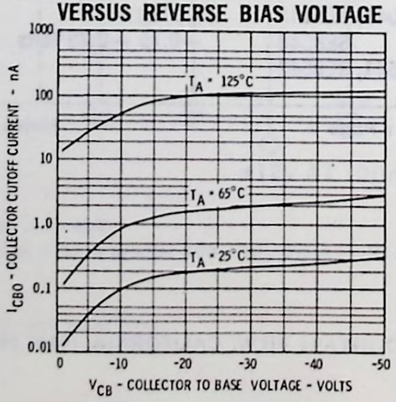
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



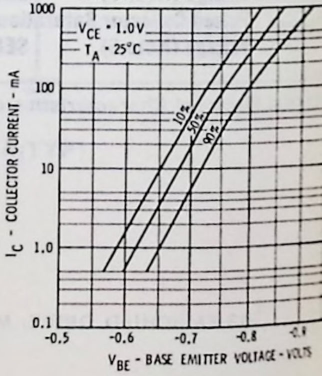
COLLECTOR SATURATION VOL VERSUS COLLECTOR CURRE



COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE

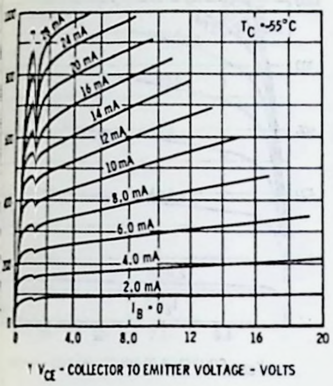


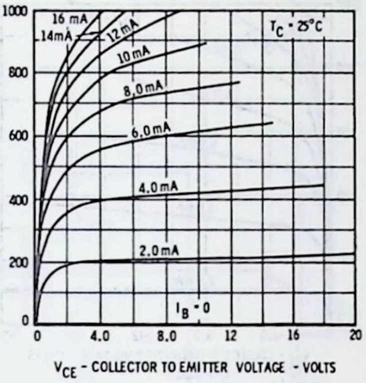
DISTRIBUTION OF BASE EMITTER VOLTAGE VERSUS COLLECTOR CURRE

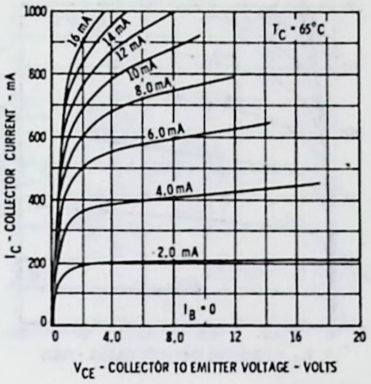


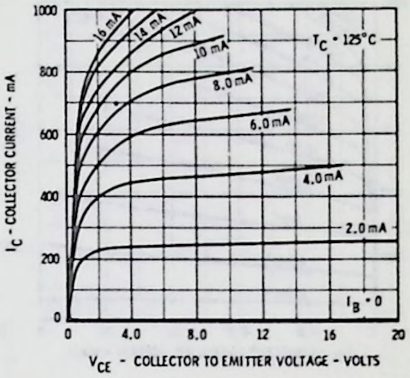
SE8040 • SE8041 • SE8042

TYPICAL LARGE SIGNAL COLLECTOR CHARACTERISTICS

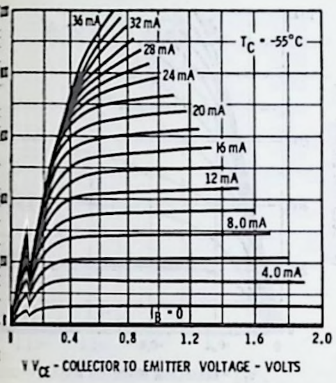


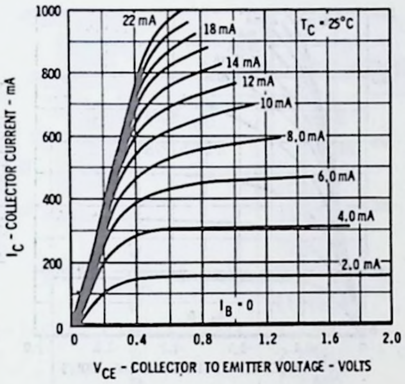


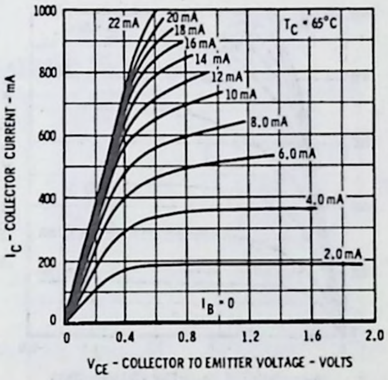


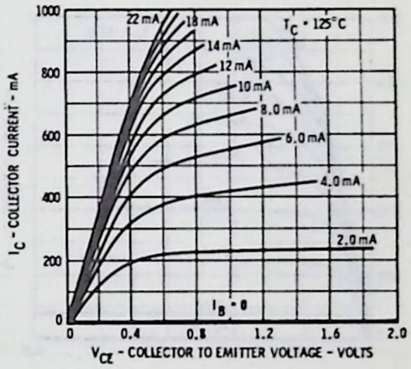


TYPICAL COLLECTOR SATURATION CHARACTERISTICS

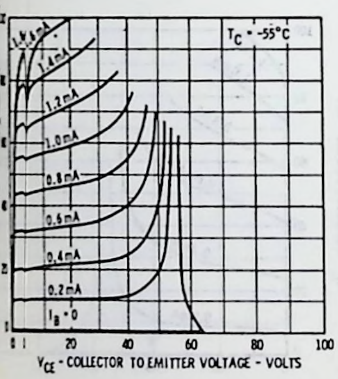


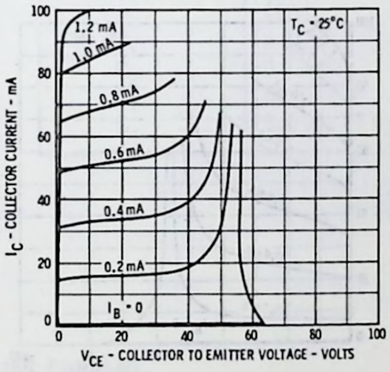


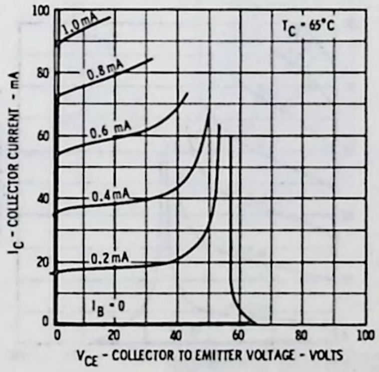


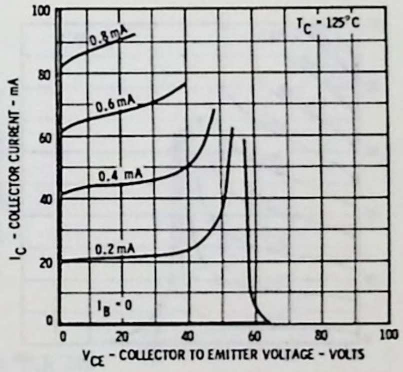


TYPICAL SMALL SIGNAL COLLECTOR CHARACTERISTICS

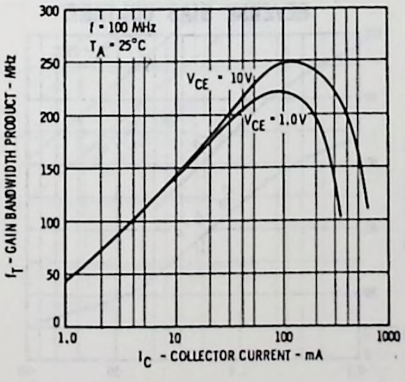




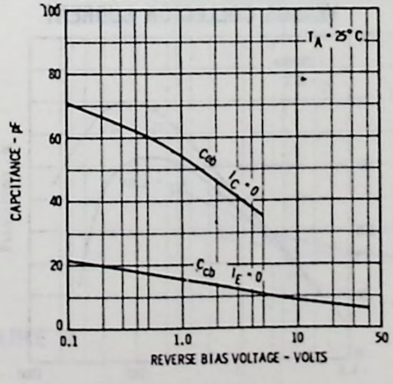




GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

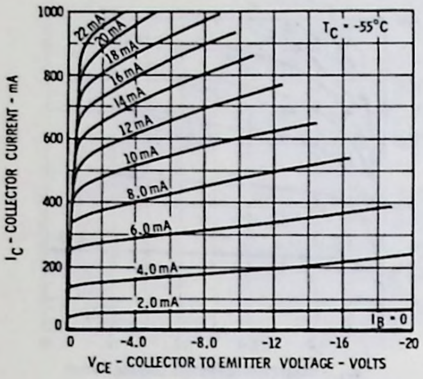


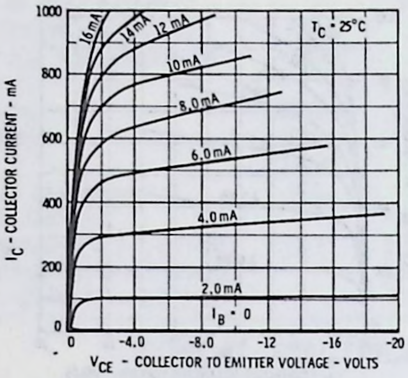
COLLECTOR TO BASE AND EMITTER TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

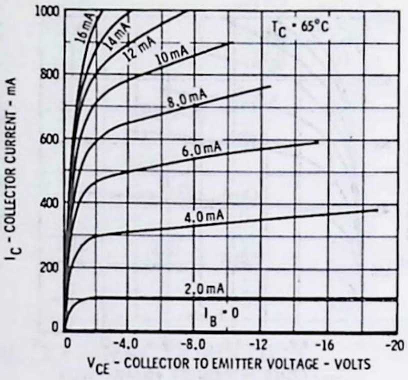


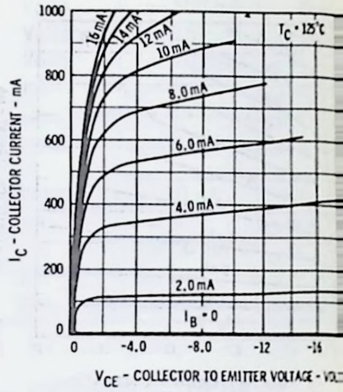
SE8540 • SE8541 • SE8542

TYPICAL LARGE SIGNAL COLLECTOR CHARACTERISTICS

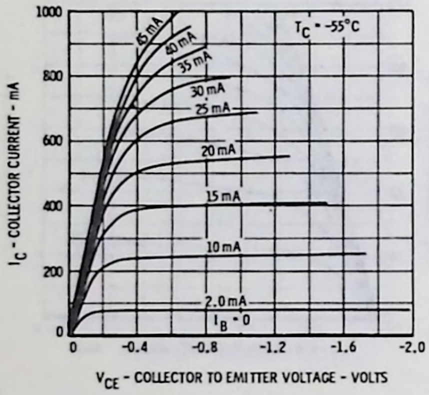


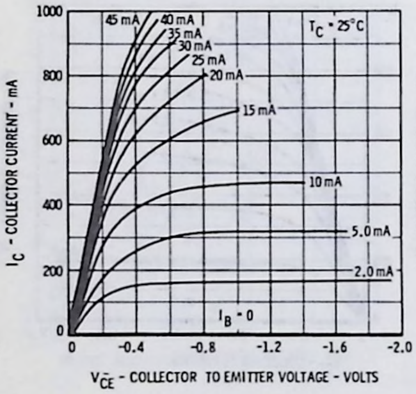


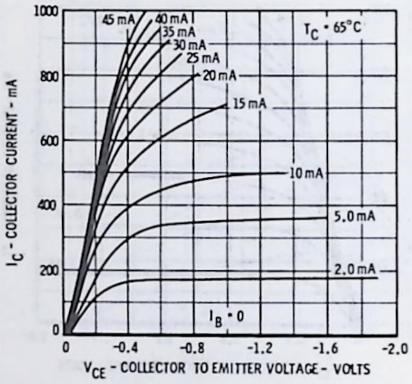


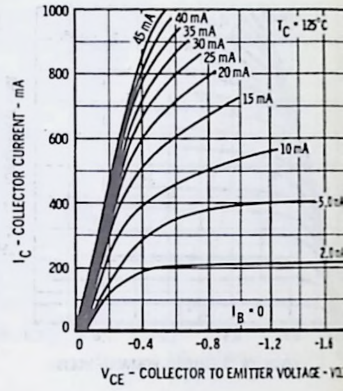


TYPICAL COLLECTOR SATURATION CHARACTERISTICS

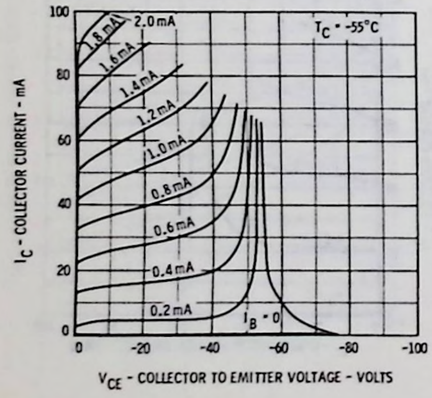


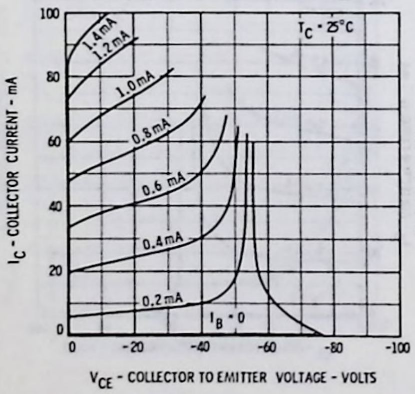


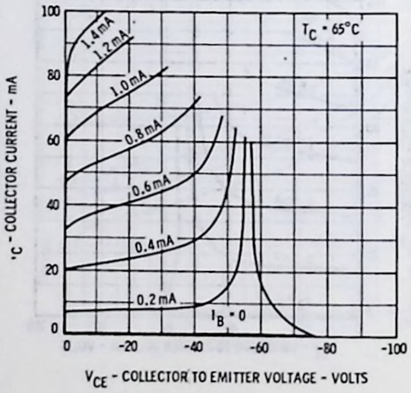


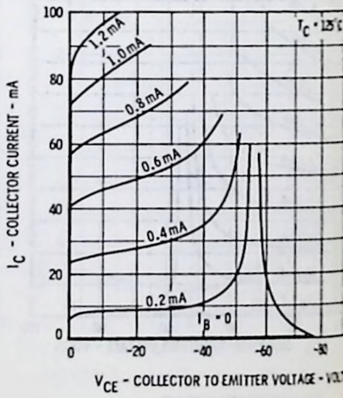


TYPICAL SMALL SIGNAL COLLECTOR CHARACTERISTICS

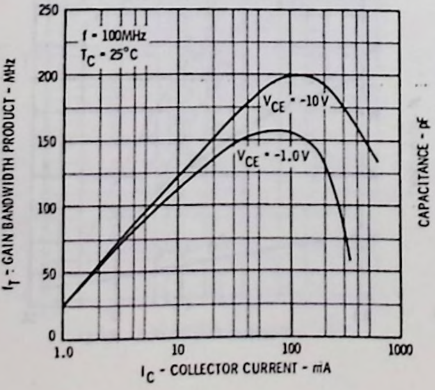








GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



COLLECTOR-BASE AND EMITTER BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

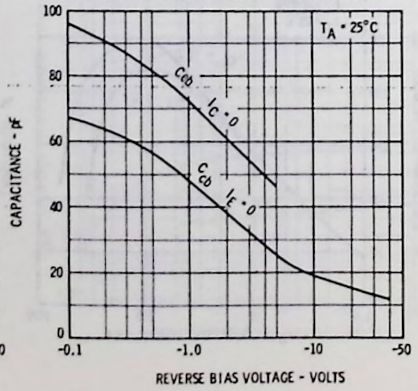


Figure 1—SCHEMATIC DIAGRAM

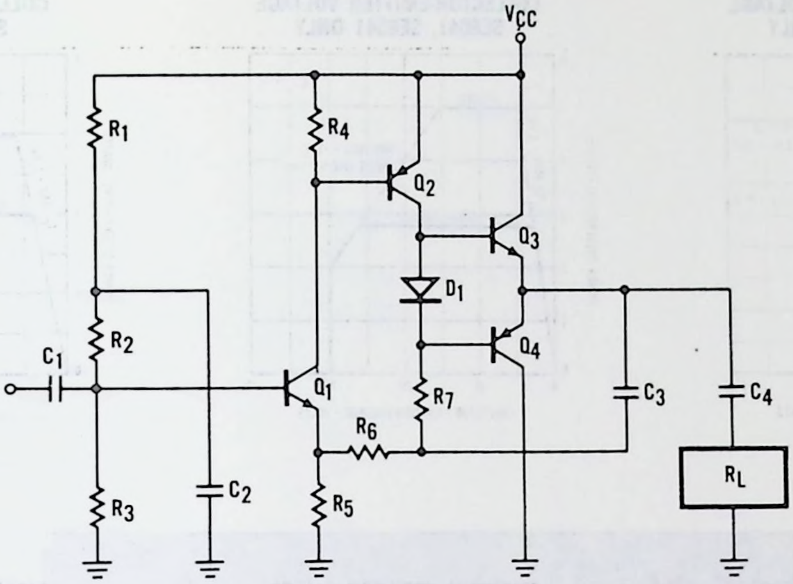
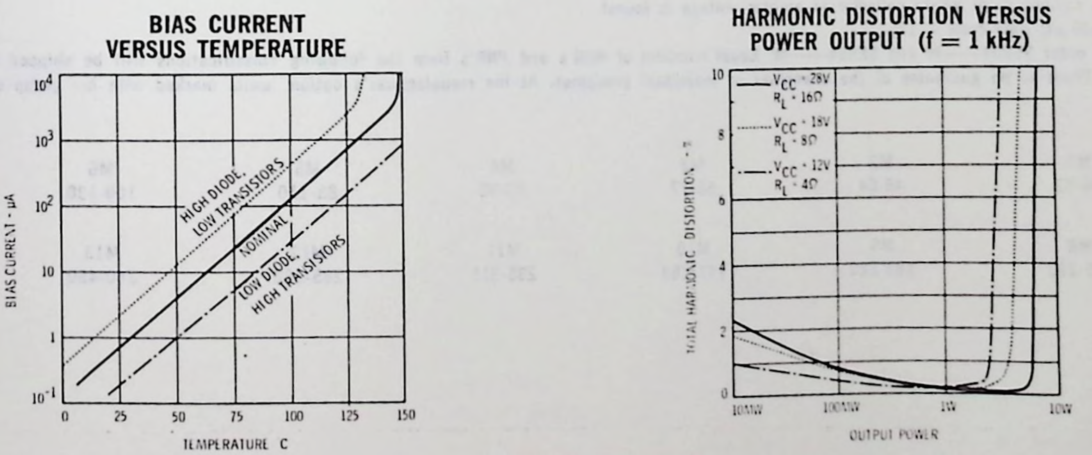


Table 1—SCHEMATIC VALUES

Circuit Voltage Load Resistance	12 V 4 ohm	18 V 8 ohm	28 V 16 ohm
Q_1	SE4021	SE4021	SE4021
Q_2	2N4249	2N3638	2N3638
Q_3	SE8040	SE8040	SE8042
Q_4	SE8540	SE8540	SE8542
D_1	FDH694	FDH694	FDH694
R_1	2.2 MΩ	4.7 MΩ	5.6 MΩ
R_2	2.7 MΩ	4.7 MΩ	10 MΩ
R_3	1.2 MΩ	1.2 MΩ	1 MΩ
R_4	22 kΩ	22 kΩ	22 kΩ
R_5	100 Ω	47 kΩ	56 Ω
R_6	180 Ω	180 Ω	470 Ω
R_7	120 Ω	120 Ω	150 Ω
C_1	0.01 μF	0.01 μF	0.01 μF
C_2	0.01 μF	0.01 μF	0.01 μF
C_3	50 μF, 6 V	25 μF, 6 V	25 μF, 6 V
C_4	500 μF, 10 V	500 μF, 15 V	250 μF, 20 V

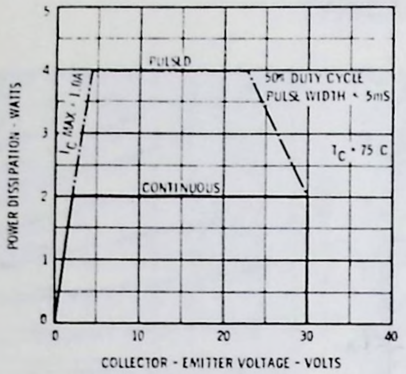

BIAS CURRENT VERSUS TEMPERATURE

HARMONIC DISTORTION VERSUS POWER OUTPUT (f = 1 kHz)

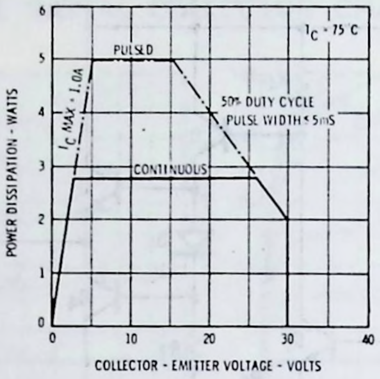
FIGURE 2

For additional information, send for Fairchild Application Brief 58

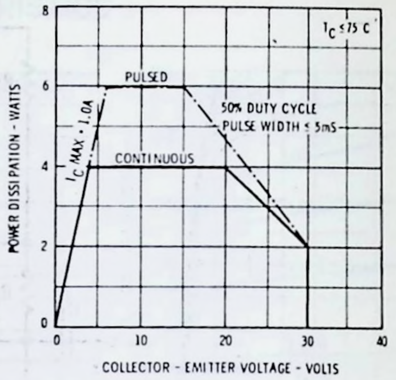
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8040, SE8540 ONLY



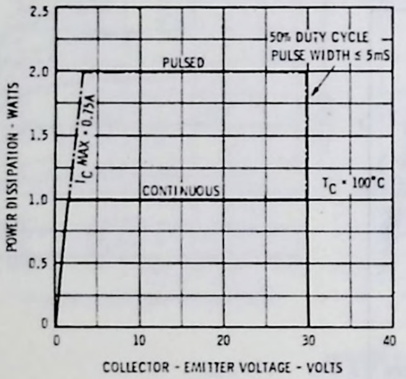
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8041, SE8541 ONLY



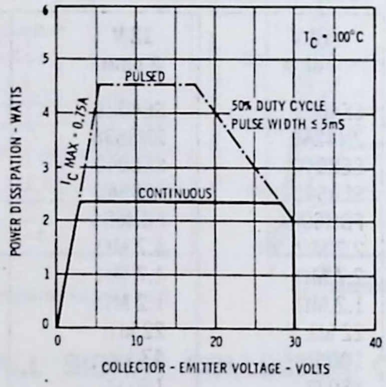
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8042, SE8542 ONLY



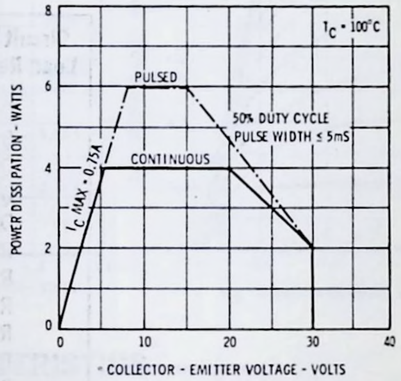
MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8040, SE8540 ONLY



MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8041, SE8541 ONLY



MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8042, SE8542 ONLY



• Reverse Voltage Polarity for SE8540, SE8541 and SE8542

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations if curves shown above will be exceeded.

(3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C) for the SE8040 and SE8540.

(4) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.7°C/Watt (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C) for the SE8041 and SE8541; junction to ambient thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C) for the SE8042 and SE8542.

(5) This rating refers to a high current point where collector to emitter voltage is lowest.

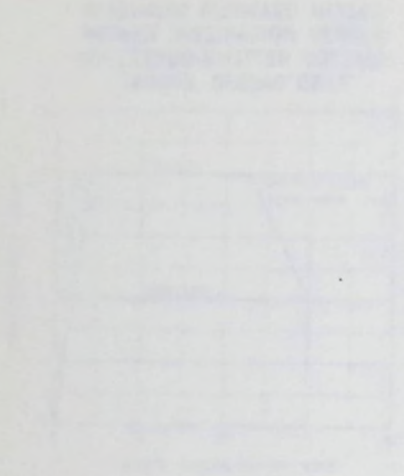
(6) Pulse Conditions: length = 300 μs; duty cycle = 1%.

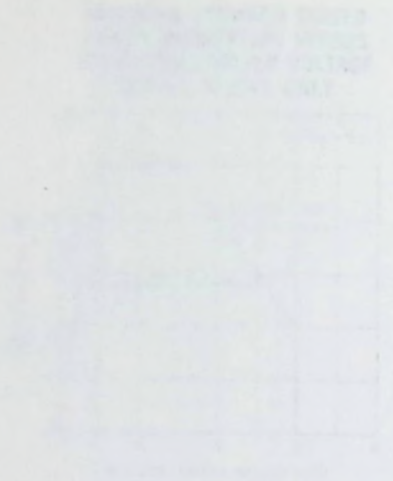
(7) If h_{FE} matching is required, order SE804——M and SE854——M. Equal numbers of NPN's and PNP's from the following classifications will be shipped and will be marked to indicate matching group(s). There is no guarantee of the quantities of individual groupings. At the manufacturer's option, units marked with h_{FE} group suffixes (M1, etc.) may be shipped as SE8040 etc.

GROUP	M1	M2	M3	M4	M5	M6	M7
h_{FE} RANGE	40-52	48-64	58-77	70-93	83-110	100-130	118-150
	M8	M9	M10	M11	M12	M13	M14
I_C = 150 mA V_{CE} = 1.0 V	135-183	163-220	197-263	235-315	285-380	340-450	410-540

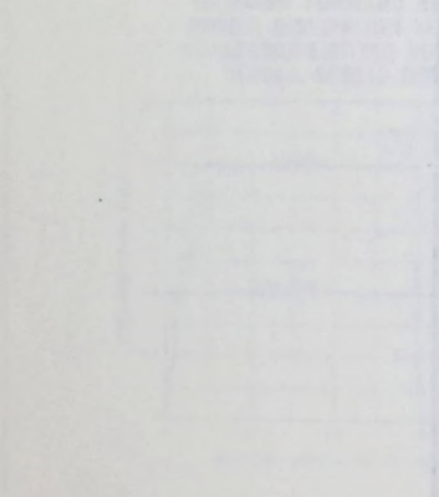
Diodes

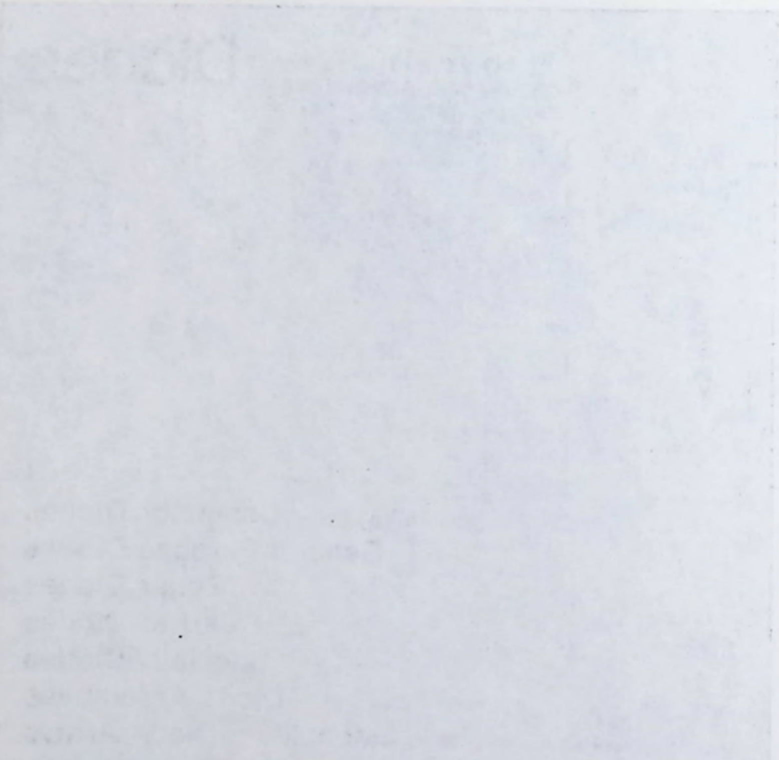
Computer Diodes
General Purpose Diodes
Zener Diodes
Hot Carrier Diodes
Specialty Diodes
Diode Assemblies
Monolithic Diode Arrays


MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE [illegible]


MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE [illegible] ONLY

MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8540, SE8541 ONLY


MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE [illegible]



MAXIMUM FORWARD BIASED POWER DISSIPATION VERSUS COLLECTOR-EMITTER VOLTAGE SE8542 ONLY

NOTES:

[illegible]

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100		FDH666 FDN666 1N5319	1N914B 1N4448 1N5317
200-250		1N4450	FD600 FDH600 FDN600 1N3600 1N4150 1N4606 1N4610 1N5318 FD6666
300-400		1N4950	1N4607
500			1N5282

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SWITCHING SPEED (nSec)	0-25	26-74	75-100
0-0.75	FD777 1N4244 1N4376 1N4376 JAN	FD700	1N3062 1N5282 1N5317
1.0-2.0		1N3605 1N4152 1N4533	
4.0	1N252 1N3596	FDH666 FDN666 1N4450 1N4950 1N5319	FD100 FD600 FDH600 FDN600 1N914 1N3063 1N3064 1N3065 1N3600 1N4148 1N4150 1N4151 1N4446 1N4447 1N4448 1N4454 1N4531 1N4532 1N4606 1N4607 1N4610 1N5318
5.0		1N3603	FD111 1N3602 FD6666

COMPUTER DIODE SELECTION GUIDE

	BREAKDOWN VOLTAGE (VOLTS)		
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1.1-1.9	1N3065		FD777
2.0	FD100 1N3063 1N3064 1N4151 1N4447 1N4454 1N4532 1N4610 FD6666		
2.5	FD111 FD600 FDH600 FDN600 1N3600 1N4150 1N4606 1N5282 1N5317 1N5318	1N5319	
3.4-4.0	1N914 1N4148 1N4446 1N4448 1N4607	1N251 JAN FDH666 FDN666 1N4450 1N4531 1N4727 1N4950	

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GENERAL PURPOSE DIODE SELECTION GUIDE

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100-149	1N662		1N658 1N808	1N837 1N844
50-99	1N457	1N795 1N891 1N3069	1N483A 1N483B	1N840
0-49	1N456 1N925 1N926	1N791	1N482A 1N292	

	FORWARD CURRENT (mA)			
LEAKAGE CURRENT (nA)	**0-49**	**50-99**	**100-149**	**150-200**
>75	1N662 1N813 1N815	1N791 1N804	FD400 FDH400 1N3070 1N3071	1N837 1N838 1N839 1N4363
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Voltage Variable Capacitor	Low Voltage	FV1012	5-126	Reference Diode	Low TC Series	FCT1121	5-
Voltage Variable Capacitor	Low Voltage	FV1014	5-126	Reference Diode	Low TC Series	FCT1135	5-
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Voltage Variable Capacitor	High Voltage	FV1106	5-126	Reference Diode	Multi-Current Series	MCR2222	5-
Voltage Variable Capacitor	High Voltage	FV1108	5-126	Reference Diode	Multi-Current Series	MCR2221	5
Voltage Variable Capacitor	High Voltage	FV1110	5-126	Reference Diode	Multi-Current Series	MCR2235	5
Voltage Variable Capacitor	High Voltage	FV1112	5-126	Reference Diode	Multi-Current Series	MCR2525	5
Voltage Variable Capacitor	High Voltage	FV1114	5-126	Reference Diode	Multi-Current Series	MCR2522	5
Voltage Variable Capacitor	High Voltage	FV1116	5-126	Reference Diode	Multi-Current Series	MCR2521	5
Pico Ampere Diode	Ultra Low Leakage	FJT1000	5-122	Reference Diode	Multi-Current Series	MCR2535	5
Pico Ampere Diode	Ultra Low Leakage	FJT2000	5-141	Reference Diode	Multi-Current Series	MCR2025	5
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Reference Diode	Low TC Series	FCT1022	5-88	Reference Diode	Multi-Current Series	MCR2021	5
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DIODE ASSEMBLIES SELECTION GUIDE/INDEX

GLASS DIODE ASSEMBLIES Description	Forward Voltage Match (mV)	Device Type	Page No.
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Encapsulated Pair	10.0	1N4306JAN	5-30
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Encapsulated Pair	10.0	FA2311E	5-80
Encapsulated Pair	5.0	FA2312E	5-80
Encapsulated Pair	15.0	FA2313E	5-80
Encapsulated Pair	3.0	FA2320E	5-80
Encapsulated Pair	10.0	FA2321E	5-80
Encapsulated Pair	5.0	FA2322E	5-80
Encapsulated Pair	15.0	FA2323E	5-80
Encapsulated Pair	10.0	FA2324E	5-80
Encapsulated Pair	20.0	FA2325E	5-80
Encapsulated Pair	10 mV	FA2330E	5-80
Encapsulated Pair	15 mV	FA2331E	5-80
Encapsulated Pair	20 mV	FA2332E	5-80
Encapsulated Pair	10 mV	FA2333E	5-80
Encapsulated Pair	15 mV	FA2334E	5-80
Encapsulated Pair	20 mV	FA2335E	5-80
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Encapsulated Pair	20.0	FA2361E	5-80
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Unencapsulated Pair	10.0	FA2311U	5-80
Unencapsulated Pair	5.0	FA2312U	5-80
Unencapsulated Pair	15.0	FA2313U	5-80
Unencapsulated Pair	3.0	FA2320U	5-80
Unencapsulated Pair	10.0	FA4321U	5-80
Unencapsulated Pair	5.0	FA2322U	5-80
Unencapsulated Pair	15.0	FA2323U	5-80
Unencapsulated Pair	10.0	FA2324U	5-80
Unencapsulated Pair	10 mV	FA2331U	5-80
Unencapsulated Pair	15 mV	FA2331U	5-80
Unencapsulated Pair	20 mV	FA2332U	5-80
Unencapsulated Pair	10 mV	FA2333U	5-80
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Bridges	10.0	FA3311	5-80
Bridges	5.0	FA3312	5-80
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Bridges	5.0	FA3322	5-80
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Bridges	15.0	FA3331	5-80
Bridges	20.0	FA3332	5-80
Bridges	10.0	FA3333	5-80
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Encapsulated Quad	10.0	FA4311E	5-80
Encapsulated Quad	5.0	FA4312E	5-80
Encapsulated Quad	15.0	FA4313E	5-80
Encapsulated Quad	3.0	FA4320E	5-80
Encapsulated Quad	10.0	FA4321E	5-80
Encapsulated Quad	5.0	FA4322E	5-80
Encapsulated Quad	15.0	FA4323E	5-80
Encapsulated Quad	10.0	FA4324E	5-80
Encapsulated Quad	20.0	FA4325E	5-80
Encapsulated Quad	10.0	FA4330E	5-80
Encapsulated Quad	15.0	FA4331E	5-80
Encapsulated Quad	20.0	FA4332E	5-80
Encapsulated Quad	10.0	FA4333E	5-80
Encapsulated Quad	15.0	FA4334E	5-80
Encapsulated Quad	20.0	FA4335E	5-80
Encapsulated Quad	10.0	FA4360E	5-80
Encapsulated Quad	20.0	FA4361E	5-80
Unencapsulated Quad	3.0	FA4310U	5-80
Unencapsulated Quad	10.0	FA4311U	5-80
Unencapsulated Quad	5.0	FA4312U	5-80
Unencapsulated Quad	15.0	FA4313U	5-80
Unencapsulated Quad	3.0	FA4320U	5-80
Unencapsulated Quad	10.0	FA4321U	5-80
Unencapsulated Quad	5.0	FA4322U	5-80
Unencapsulated Quad	15.0	FA4323U	5-80
Unencapsulated Quad	10.0	FA4324U	5-80
Unencapsulated Quad	20.0	FA4325U	5-80
Unencapsulated Quad	10.0	FA4330U	5-80
Unencapsulated Quad	15.0	FA4331U	5-80
Unencapsulated Quad	20.0	FA4332U	5-80
Unencapsulated Quad	10.0	FA4333U	5-80
Unencapsulated Quad	15.0	FA4334U	5-80
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DIODE ASSEMBLIES SELECTION GUIDE/INDEX

CHIP ASSEMBLIES Family	Description	Device Type	Page No.
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Common Anode	2 diode	FSA1178	5-80
Common Anode	3 diode	FSA1179	5-80
Common Anode	3 diode	FSA1181	5-80
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Common Cathode	4 diode	FSA1203	5-80
Common Cathode	4 diode	FSA1173	5-80
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Common Cathode	7 diode	FSA1175	5-80
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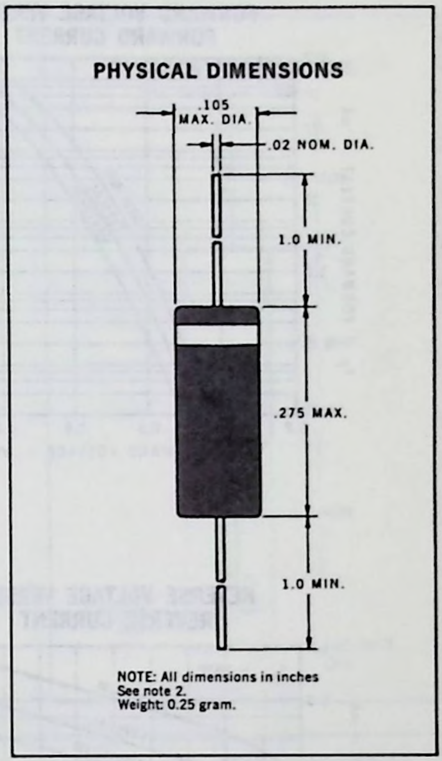
Core Driver	16 diode	FSA1412	5-1
Core Driver	8 diode	FSA1413	5-1
Core Driver	16 diode	FSA2000	5-1
Core Driver	8 diode	FSA2001	5-1
Common Cathode	8 diode	FSA2002	5-1
Common Anode	8 diode	FSA2003	5-1

1N456

HIGH CONDUCTANCE, LOW LEAKAGE, PLANAR* DIODE

ENERAL DESCRIPTION — The 1N456 is a high conductance, extremely low-leakage, planar* diode. Specified aximum values for voltage drop, capacitance, and leakage current mean flexibility in designing circuits hich require large numbers of diodes. In those applications where reverse current is a critical design parameter, the inherent qualities of the Fairchild process eliminate the problem of leakage degradation.


PHYSICAL DIMENSIONS

NOTE: All dimensions in inches
See note 2.
Weight: 0.25 gram.

SOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working inverse voltage	25 V
I_O	Average rectified current	90 mA
I_F	DC forward current	135 mA
i_f	Recurrent peak forward current	450 mA
i_f(surge)	Peak forward surge current pulse width of 1 second	700 mA
i_f(surge)	Peak forward surge current pulse width of 2 μs	1200 mA
P	Power dissipation	200 mW
$1/\theta$	Power derating factor	1.6 mW/°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	30		V	$I_R = 100\ \mu A$
I_{R1}	Reverse Current		25	nA	$V_R = 25\ V$
I_{R2}	Reverse Current (+150°C)		5	μA	$V_R = 25\ V$
V_F	Forward Voltage		1.0	V	$I_F = 40\ mA$
C	Capacitance		10	pF	$V_R = 0\ V$

*Planar is a patented Fairchild process.

TES:

The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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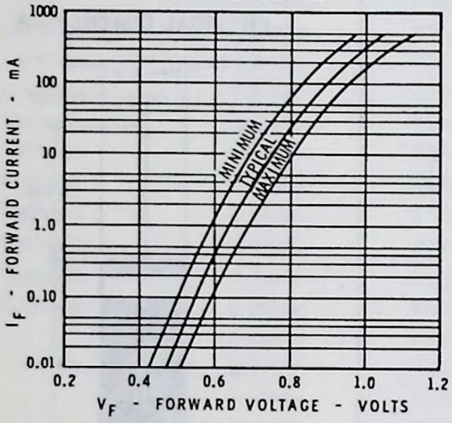
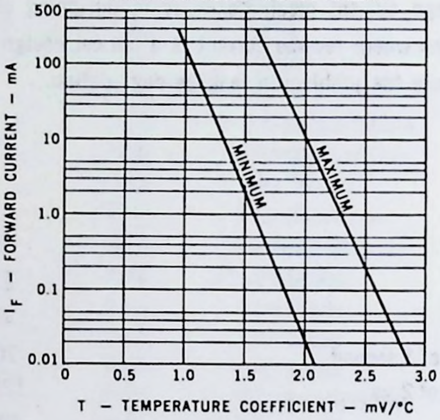
TYPICAL ELECTRICAL CHARACTERISTICS

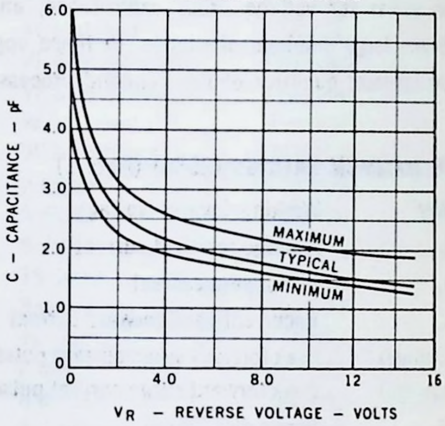
FORWARD VOLTAGE VERSUS FORWARD CURRENT



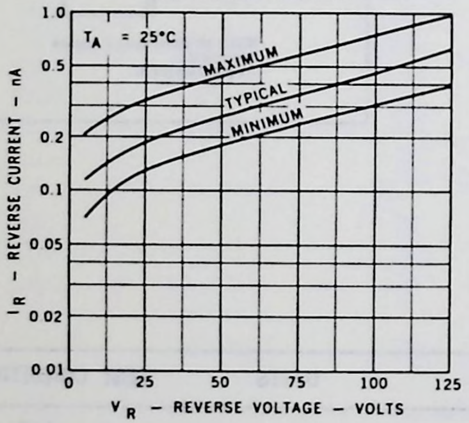
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



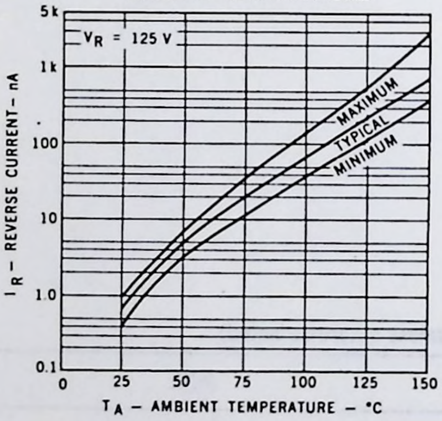
CAPACITANCE VERSUS REVERSE VOLTAGE



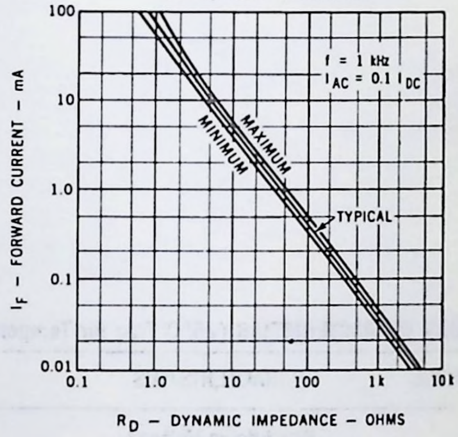
REVERSE VOLTAGE VERSUS REVERSE CURRENT



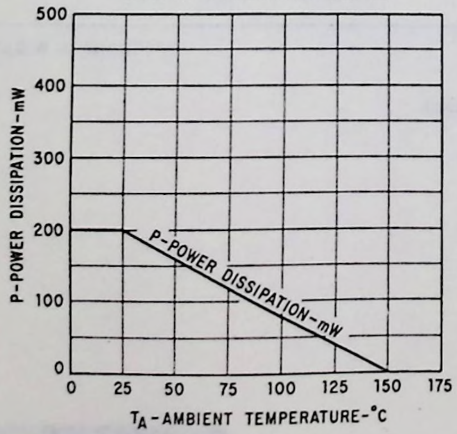
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



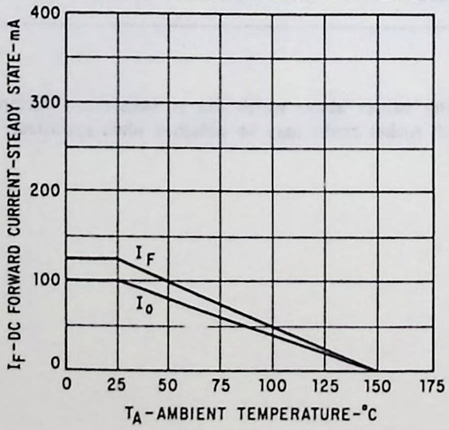
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE

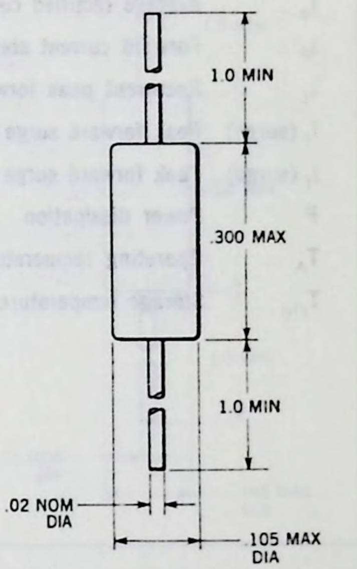


1N457
LOW LEAKAGE PLANAR* DIODE

AXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	60 V
I_o	Average Rectified Current	75 mA
i_F	Forward Current steady state d.c.	140 mA
i_f	Recurrent Peak Forward Current	225 mA
i_f (surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f (surge)	Peak Forward Surge Current Pulse Width of 1 microsecond	2 A
P	Power Dissipation	400 mW
T_A	Operating Temperature	− 65°C to + 150°C
T_{stg}	Storage Temperature, ambient	− 65°C to + 175°C

PHYSICAL DIMENSIONS
(All dimensions in inches)



ECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage			1.0	Volts	$I_F = 20$ mA
I_R	Reverse Current			25	nA	$V_R = -60$ V
I_R	Reverse Current (150°C)			5.0	μA	$V_R = -60$ V
BV	Breakdown Voltage	70			Volts	$I_R = 100$ μA
C_o	Capacitance (f = 1 MHz) [Note 2]			6.0	pF	$V_R = 0$ V

*Planar is a patented Fairchild process.

TES:
) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

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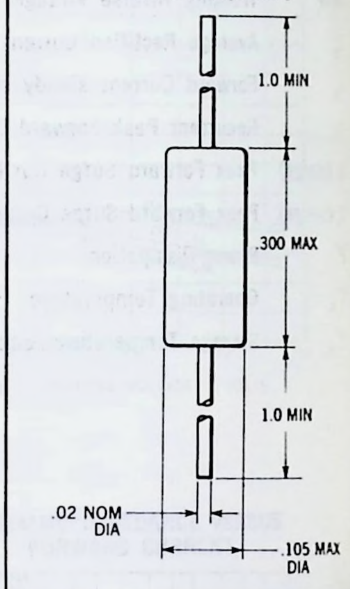
1N458
LOW LEAKAGE PLANAR* DIODE

MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	125 V
I_o	Average rectified current	55 mA
i_F	Forward current steady state d.c.	115 mA
I_f	Recurrent peak forward current	175 mA
i_f (surge)	Peak forward surge current pulse width of 1 second	500 mA
i_f (surge)	Peak forward surge current pulse width of 1 μs	2 A
P	Power dissipation	400 mW
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

PHYSICAL DIMENSIONS

(All dimensions in inches)



ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

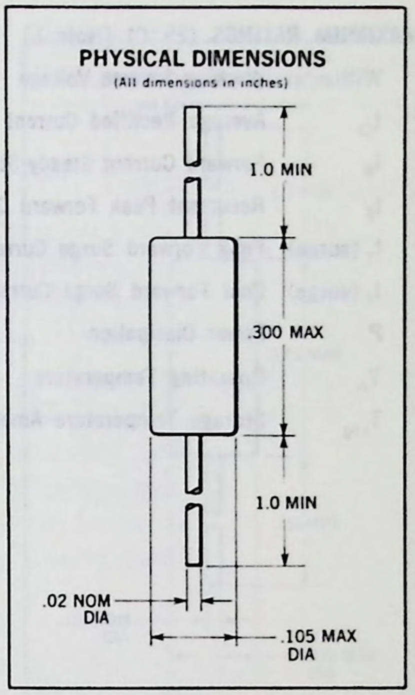
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage			1.0	Volts	$I_F = 7.0$ mA
I_R	Reverse Current			25	nA	$V_R = -125$ V
I_R	Reverse Current (150°C)			5.0	μA	$V_R = -125$ V
BV	Breakdown Voltage	150			Volts	$I_R = 100$ μA
C_o	Capacitance (f = 1 MHz) [Note 2]			6.0	pF	$V_R = 0$ V

* Planar is a patented Fairchild proc

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

1N459
LOW LEAKAGE PLANAR* DIODES



AXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	175 V
I_o	Average rectified current	40 mA
i_F	Forward current steady state d.c.	100 mA
	Recurrent peak forward current	125 mA
i_f (surge)	Peak forward surge current pulse width of 1 second	500 mA
i_f (surge)	Peak forward surge current pulse width of 1 microsecond	2 A
P	Power dissipation	400 mW
T_A	Operating temperature	−65° to +150°C
T_{stg}	Storage temperature, ambient	−65° to +175°C

CTRICAL SPECIFICATIONS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage			1.0	Volts	$I_F = 3.0$ mA
I_R	Reverse Current			25	nA	$V_R = -175$ V
I_R	Reverse Current (150°C)			5.0	μA	$V_R = -175$ V
BV	Breakdown Voltage	200			Volts	$I_R = 100$ μA
C_o	Capacitance (f = 1 MHz) [Note 2]			6.0	pF	$V_R = 0$ V

* Planar is a patented Fairchild process.

ES:

The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

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1N485B

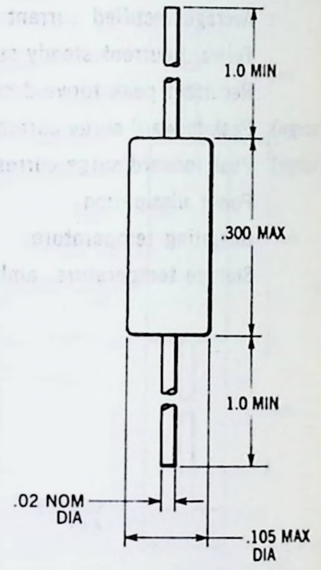
LOW LEAKAGE HIGH CONDUCTANCE HIGH VOLTAGE PLANAR* DIODE

MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	175 V
I_O	Average Rectified Current	200 mA
I_F	Forward Current Steady State d.c.	375 mA
I_F	Recurrent Peak Forward Current	450 mA
I_f (surge)	Peak Forward Surge Current Pulse Width of 1 Second	1.0 A
I_f (surge)	Pear Forward Surge Current Pulse Width of 1 μs	4.0 A
P	Power Dissipation	400 mW
T_A	Operating Temperature	− 65°C to + 150°C
T_{stg}	Storage Temperature Ambient	− 65°C to + 175°C

PHYSICAL DIMENSIONS

(All dimensions in inches)



ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	TEST CONDITIONS
V_F	Forward Voltage			1.0 V	$I_F = 100$ mA
I_R	Reverse Current			25 nA	$V_R = -175$ V
I_R	Reverse Current (150°C)			5.0 μA	$V_R = -175$ V
B_V	Breakdown Voltage	200 V			$I_R = 100\ \mu$A
C_o [Note 2]	Capacitance			6.0 pF	$V_R = 0$ V

*Planar is a patented Fairchild process.

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

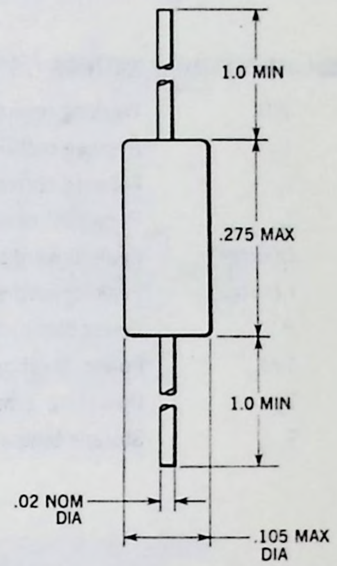
1N658

HIGH CONDUCTANCE, HIGH SPEED PLANAR* DIODE

AXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	100 V
I_o	Average Rectified Current	100 mA
I_F	Forward Current Steady State d.c.	150 mA
i_f	Recurrent Peak Forward Current	300 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f(surge)	Peak Foward Surge Current Pulse Width of 1 μs	2000 mA
P°	Power Dissipation	250 mW
P°	Power Dissipation	100 mW @ 125°C
T_A	Operating Temperature	−65°C to +175°C
T_{stg}	Storage Temperature, Ambient	−65°C to +200°C

PHYSICAL DIMENSIONS
(All dimensions in inches)



CTRICAL SPECIFICATIONS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	TEST CONDITIONS
V_F	Forward Voltage			1.0 V	$I_F = 100$ mA
I_R	Reverse Current			0.05 μA	$V_R = -50$ V
I_R	Reverse Current (150°C)			25 μA	$V_R = -50$ V
B_V	Breakdown Voltage	120 V			$I_R = 100$ μA
t_{rr} (Note 2)	Reverse Recovery Time			300 ns	$I_f = 5$ mA $V_r = -40$ V $R_L = 150\ \Omega$

*Planar is a patented Fairchild process.

TES:

These maximum ratings are limiting values above which life or satisfactory performance may be impaired.
Recovery to 80K ohms in JAN 258 circuit.

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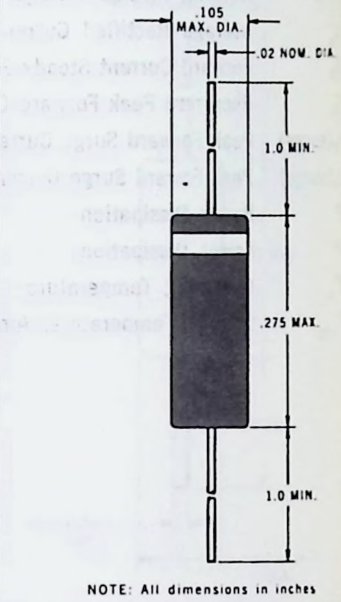
1N662

HIGH SPEED, HIGH CONDUCTANCE PLANAR* DIODE

GENERAL DESCRIPTION — The 1N662 is a high conductance ultra-fast planar diode. This device couples high speed with high conductance and high breakdown voltage, and enables the designer to choose a diode with planar reliability to fulfill most general-purpose switching applications.

PHYSICAL DIMENSIONS



SEE NOTE 3

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working inverse voltage	80 V
I_O	Average rectified current	100 mA
I_F	Forward current steady state DC	340 mA
i_f	Recurrent peak forward current	300 mA
i_f(surge)	Peak forward surge current pulse width of 1.0 second	.5 A
i_f(surge)	Peak forward surge current pulse width of 1.0 μs	2 A
P	Power dissipation	400 mW
$1/\theta$	Power derating factor	3.2 mW/°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

SYMBOL	CHARACTRISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
I_{R1}	Reverse Current (+25°C)		20	μA	$V_R = 50$ V
I_{R2}	Reverse Current (+100°C)		100	μA	$V_R = 50$ V
I_{R3}	Reverse Current (+25°C)		1.0	μA	$V_R = 10$ V
I_{R4}	Reverse Current (+100°C)		20	μA	$V_R = 10$ V
V_F	Forward Voltage		1.0	V	$I_F = 10$ mA
BV	Breakdown Voltage	100		V	$I_R = 100\ \mu$A
T_{RR}	Reverse Recovery Time		500	ns	(Note 2)
C	Capacitance		3.0	pF	$V_R = 10$ V

*Planar is a patented Fairchild process

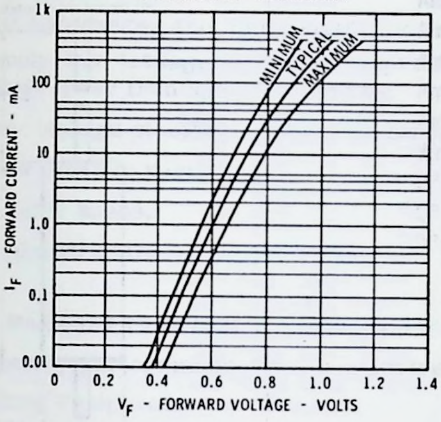
NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) $V_R = 40$ V; $I_F = 5$ mA; $R_L = 2.3$ kΩ; $C_L = 40$ pF; Recovery to 100 k.
(3) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

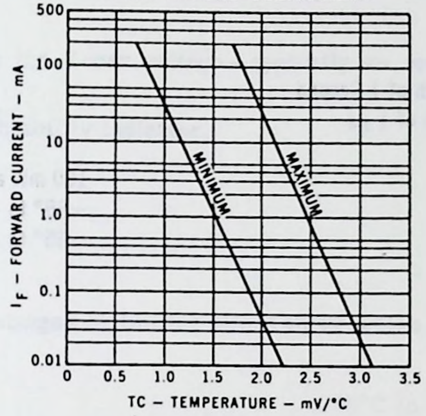
FAIRCHILD DIODE IN662

TYPICAL ELECTRICAL CHARACTERISTICS

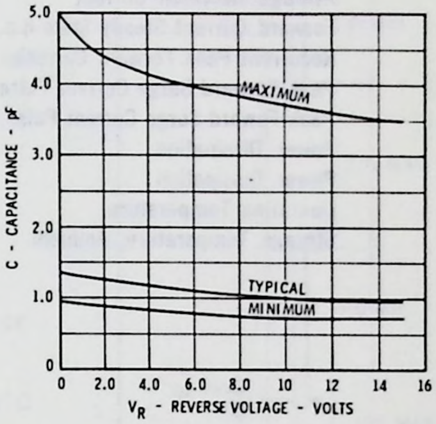
FORWARD VOLTAGE VERSUS FORWARD CURRENT



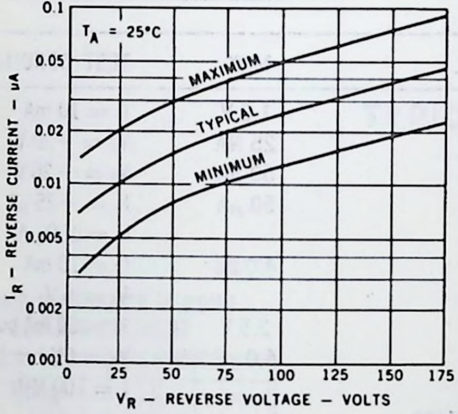
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



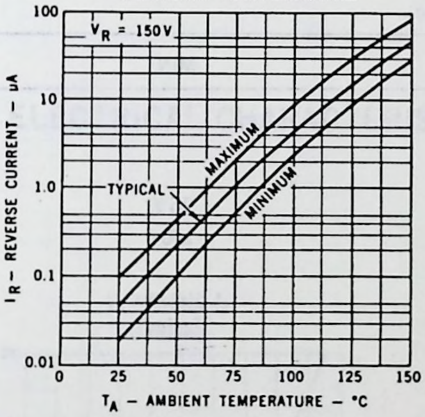
CAPACITANCE VERSUS REVERSE VOLTAGE



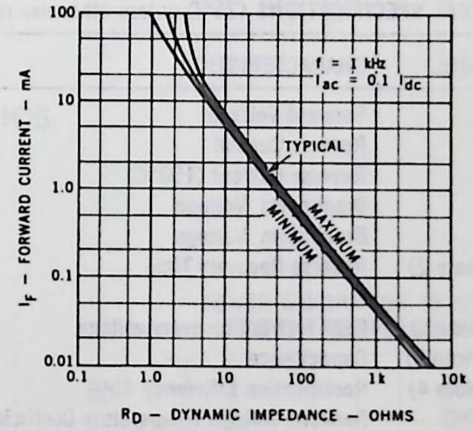
REVERSE CURRENT VERSUS REVERSE VOLTAGE



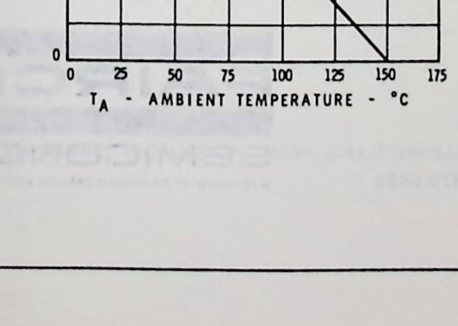
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



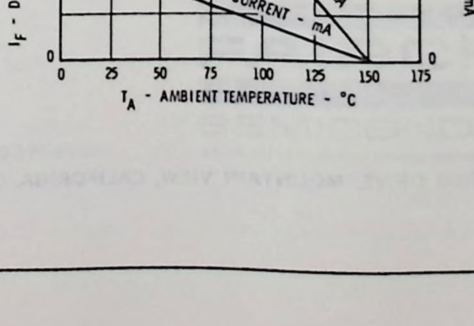
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



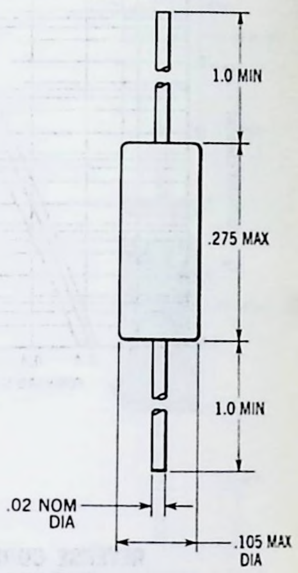
1N914
ULTRA FAST PLANAR* DIODE

MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	20 V
I_O	Average Rectified Current	50 mA
I_F	Forward Current Steady State d.c.	75 mA
I_F	Recurrent Peak Forward Current	150 mA
$i_{f(surge)}$	Peak Forward Surge Current Pulse Width of 1 Second	500 mA
$i_{f(surge)}$	Peak Foward Surge Current Pulse Width of 1 μs	2000 mA
P	Power Dissipation	250 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	−65° to +175°C
T_{stg}	Storage Temperature, Ambient	−65° to +175°C

PHYSICAL DIMENSIONS

(All dimensions in inches)



ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	TEST CONDITIONS
V_F	Forward Voltage			1.0 V	$I_F = 10$ mA
I_R	Reverse Current			25 NA	$V_R = -20$ V
I_R	Reverse Current (150°C)			50 μA	$V_R = -20$ V
BV	Breakdown Voltage	75 V		50 μA	$I_R = -25$ μA
BV	Breakdown Voltage	100V			$I_R = 100$ μA
t_{rr} (Note 2)	Reverse Recovery Time			4.0 ns	$I_F = 10$ mA $V_R = 6$ V
V_F (Note 5)	Peak forward recovery voltage			2.5 V	$I_F = 50$ mA pulse
C_O (Note 3)	Capacitance			4.0 pF	$V_R = 0$V f = 1
R_E (Note 4)	Rectification Efficiency 45%				f = 100 MHz
ΔV_F/°C	Forward Voltage Temperature Coefficient		−1.8mV/°C		

*Planar is a patented Fairchild process

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 1 mA.

(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

(4) Rectification efficiency is defined as the ratio of D.C. load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V r.m.s. input to the circuit. Load resistance 5k ohms, load capacitance 20 pF.

(5) Pulse width = 0.1 μs; Rise time of pulse equal to or less than 25 ns. Repetition rate 5 - 100 kHz.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD SILICON PLANAR* ZENER DIODES

400 MILLIWATT VOLTAGE REGULATORS

1N746–1N759 SERIES & 1N957–1N992 SERIES

ENERAL DESCRIPTION - The Fairchild General Purpose Voltage Regulator is a Silicon anar Diode designed for a wide range of voltage regulation and voltage limiting applications. ilizing the Planar process, these devices offer, ultra-stable reverse voltage, low leakage, dynamic impedance, and high reliability.

Extremely low leakage at biases approaching the Zener voltage — typically an order of magnitude lower than specified values.

Extreme leakage stability. This is a strong reliability indicator.

Very low dynamic resistance.

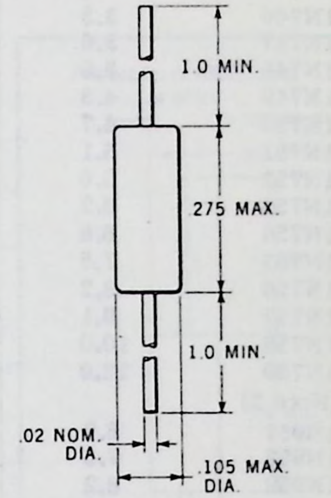
Sharp Zener knees.

Planar Construction above 5.6 volts.

SOLUTE MAXIMUM RATINGS - The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

Operating Temperature	-65°C to +150°C
Storage Temperature	-65°C to +175°C
Power Dissipation	400 mW
Power Derating Factor	3.2 mW/°C

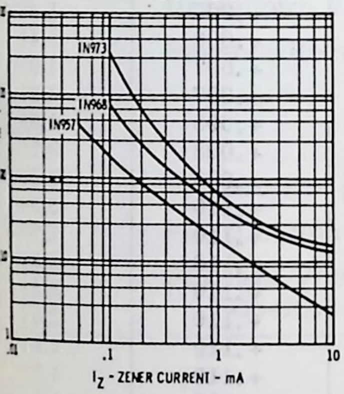
PHYSICAL DIMENSIONS



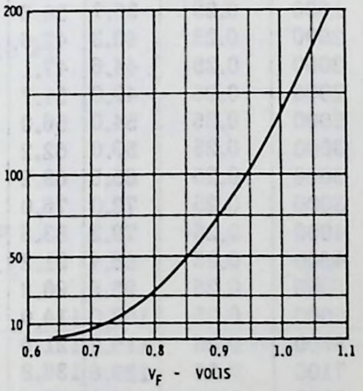
NOTES: All dimensions in inches.
Weight: 0.25 gram.

TYPICAL ELECTRICAL CHARACTERISTICS

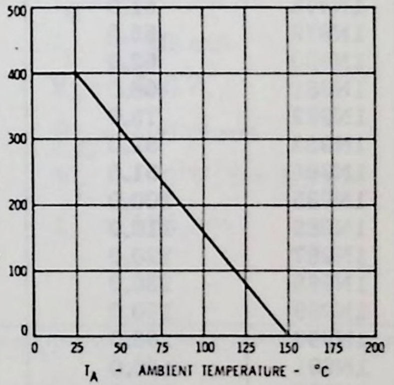
ZENER IMPEDANCE VERSUS REVERSE CURRENT



V_F VERSUS I_F (Typical)



POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



*Planar is a patented Fairchild process.

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FAIRCHILD 400 MILLIWATT VOLTAGE REGULATORS

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

JEDEC Type No.	V_z Zener Voltage Nominal	I_{zT} Test Current	Z_z Max. Zener Impedance (Note 3)			V_R Reverse Voltage (Note 5)		I_R Max. Reverse Current @ V_R		T.C. Temperature Coefficient (Maximum)	I_{zm} Max. Curre (Note 4)
			Z_{zT} at I_{zT}	Z_{zk} at I_{zk}				25°C	150°C		
	Volts	mA	Ohms	Ohms	mA	Volts		µA	µA	%/°C	mA
(Note 1)						A	B				
1N746	3.3	20.00	28.0			1.0		10.00	30.0	-.070	110.0
1N747	3.6	20.00	24.0			1.0		10.00	30.0	-.065	100.0
1N748	3.9	20.00	23.0			1.0		10.00	30.0	-.060	95.0
1N749	4.3	20.00	22.0			1.0		2.00	30.0	-.055	85.0
1N750	4.7	20.00	19.0			1.0		2.00	30.0	-.043	75.0
1N751	5.1	20.00	17.0			1.0		1.00	20.0	±.030	70.0
1N752	5.6	20.00	11.0			1.0		1.00	20.0	±.028	65.0
1N753	6.2	20.00	7.0			1.0		0.10	20.0	+.045	60.0
1N754	6.8	20.00	5.0			1.0		0.10	20.0	+.050	55.0
1N755	7.5	20.00	6.0			1.0		0.10	20.0	+.058	50.0
1N756	8.2	20.00	8.0			1.0		0.10	20.0	+.062	45.0
1N757	9.1	20.00	16.0			1.0		0.10	20.0	+.068	40.0
1N758	10.0	20.00	17.0			1.0		0.10	20.0	+.075	35.0
1N759	12.0	20.00	50.0			1.0		0.10	20.0	+.077	30.0
(Note 2)											
1N957	6.8	18.50	4.5	700	1.0	4.9	5.2	10.00	50.0	+.050	47.0
1N958	7.5	16.50	5.5	700	0.5	5.4	5.7	10.00	50.0	+.058	42.0
1N959	8.2	15.00	6.5	700	0.5	5.9	6.2	5.00	50.0	+.062	38.0
1N960	9.1	14.00	7.5	700	0.5	6.6	6.9	1.00	10.0	+.068	35.0
1N961	10.0	12.50	8.5	700	0.25	7.2	7.6	1.00	10.0	+.072	32.0
1N962	11.0	11.50	9.5	700	0.25	8.0	8.4	1.00	5.0	+.073	28.0
1N963	12.0	10.50	11.5	700	0.25	8.6	9.1	1.00	5.0	+.076	26.0
1N964	13.0	9.50	13.0	700	0.25	9.4	9.9	0.10	5.0	+.079	24.0
1N965	15.0	8.50	16.0	700	0.25	10.8	11.4	0.10	5.0	+.082	21.0
1N966	16.0	7.80	17.0	700	0.25	11.5	12.2	0.10	5.0	+.083	19.0
1N967	18.0	7.00	21.0	750	0.25	13.0	13.7	0.10	5.0	+.085	17.0
1N968	20.0	6.20	25.0	750	0.25	14.4	15.2	0.10	5.0	+.086	15.0
1N969	22.0	5.60	29.0	750	0.25	15.8	16.7	0.10	1.0	+.087	14.0
1N970	24.0	5.20	33.0	750	0.25	17.3	18.2	0.10	1.0	+.088	13.0
1N971	27.0	4.60	41.0	750	0.25	19.4	20.6	0.10	1.0	+.090	11.0
1N972	30.0	4.20	49.0	1000	0.25	21.6	22.8	0.10	1.0	+.091	10.0
1N973	33.0	3.80	58.0	1000	0.25	23.8	25.1	0.05	1.0	+.092	9.2
1N974	36.0	3.40	70.0	1000	0.25	25.9	27.4	0.05	1.0	+.093	8.5
1N975	39.0	3.20	80.0	1000	0.25	28.1	29.7	0.05	1.0	+.094	7.8
1N976	43.0	3.00	93.0	1500	0.25	31.0	32.7	0.05	1.0	+.095	7.0
1N977	47.0	2.70	105.0	1500	0.25	33.8	35.8	0.05	1.0	+.095	6.4
1N978	51.0	2.50	125.0	1500	0.25	36.7	38.6	0.05	1.0	+.096	5.9
1N979	56.0	2.20	150.0	2000	0.25	40.3	42.6	0.05	1.0	+.096	5.4
1N980	62.0	2.00	185.0	2000	0.25	44.6	47.1	0.05	1.0	+.097	4.9
1N981	68.0	1.80	230.0	2000	0.25	49.0	51.7	0.05	1.0	+.097	4.5
1N982	75.0	1.70	270.0	2000	0.25	54.0	56.0	0.05	1.0	+.098	4.0
1N983	82.0	1.50	330.0	3000	0.25	59.0	62.2	0.05	1.0	+.098	3.7
1N984	91.0	1.40	400.0	3000	0.25	65.5	69.2	0.05	1.0	+.099	3.3
1N985	100.0	1.30	500.0	3000	0.25	72.0	76.0	0.05	1.0	+.110	3.0
1N986	110.0	1.10	750.0	4000	0.25	79.2	83.6	0.05	1.0	+.110	2.7
1N987	120.0	1.00	900.0	4500	0.25	86.4	91.2	0.05	1.0	+.110	2.5
1N988	130.0	0.95	1100.0	5000	0.25	93.6	98.8	0.05	1.0	+.110	2.3
1N989	150.0	0.85	1500.0	6000	0.25	108.0	114.0	0.05	1.0	+.110	2.0
1N990	160.0	0.80	1700.0	6500	0.25	115.2	121.6	0.05	1.0	+.110	1.9
1N991	180.0	0.68	2200.0	7100	0.25	129.6	136.8	0.05	1.0	+.110	1.7
1N992	200.0	0.65	2500.0	8000	0.25	144.0	152.0	0.05	1.0	+.110	1.5

NOTES:

(1) The 1N746-1N759 series have a standard Zener voltage tolerance of ±10%. A tolerance of ±5.0% is also available by suffixing A to the JEDEC type number.

(2) The 1N957-1N992 series have a 20% tolerance. Add suffix A for 10% tolerance, and suffix B for 5.0% tolerance.

(3) The Zener impedances Z_{zT} and Z_{zk} are derived by superimposing a 60 cycle AC signal, having an RMS value equal to 10% of the DC Zener current, on I_{zT} or I_{zk}.

(4) Maximum Zener current ratings (I_{zm}) are based on the maximum voltage of a 20% tolerance unit. For closer tolerance units or units where the actual Zener voltage (VZ) is known at the operating point, the maximum Zener current may be increased according to the derating curve.

(5) V_R Value for 20% tolerance = 80% lowest V_z value for each type.

1N753A through 1N759A, and 1N962B through 1N973B are available in Military Qualified (JAN) types.

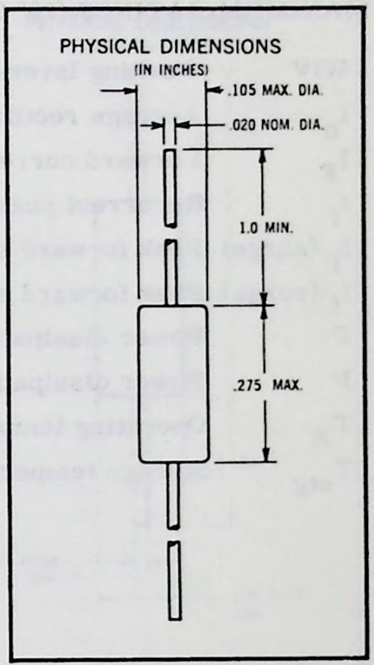
1N3062

LOW-CAPACITANCE PLANAR DIODE

1 pf AT 0 VOLTS

AXIMUM RATINGS (25° C) [Note 1]

WIV	Working Inverse Voltage	50 Volts
$_0$	Average rectified current	75 mA
$_F$	Forward current steady state d.c.	115 mA
$_f$	Recurrent peak forward current	225 mA
$_f$ (surge)	Peak forward surge current pulse width of 1.0 Second	500 mA
$_f$ (surge)	Peak forward surge current pulse width of 1.0 μSecond	2000 mA
	Power dissipation	250 mW
	Power dissipation derating factor	1.67 mW/°C
$_A$	Operating temperature	-65° C to +175° C
$_{stg}$	Storage temperature, ambient	-65° C to +200° C



ECTRICAL SPECIFICATIONS (25° C unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
V_F	Forward Voltage			1.0	Volt	I_F = 20 mA
$_R$	Reverse Current			0.1	μA	V_R = 50 V
$_R$	Reverse Current (150° C)			100	μA	V_R = 50 V
BV	Breakdown Voltage	75			Volts	I_R = 5.0 μA
$_{rr}$	Reverse Recovery Time [Note 2]			2.0	nsec	I_f = 10 mA V_r = 6.0V, R_L = 100 ohms
C_0	Capacitance [Note 3]			1.0	pf	V_R = 0 V f = 1.0 mc
RE	Rectification Efficiency [Note 4]	45			%	f = 100 mc
ΔV_F/° C	Forward Voltage Temperature Coefficient		-1.8		mV	

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ES:

The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

Recovery to 1.0 mA

Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

Rectification efficiency is defined as the ratio of D. C. load voltage to peak rf input voltage to the detector circuit, measured with 2.0V r. m. s. input to the circuit. Load resistance 5.0 K ohms, load capacitance 20pf.

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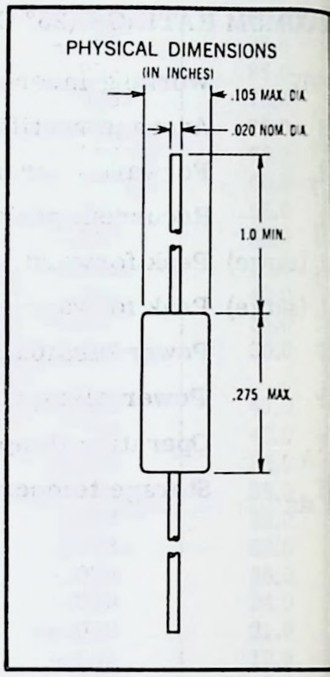
1N3063

ULTRA-FAST PLANAR DIODE

CONTROLLED FORWARD VOLTAGE

MAXIMUM RATINGS (25° C) [Note 1]

WIV	Working Inverse Voltage	50 Volts
I_o	Average rectified current	75 mA
I_F	Forward current steady state d.c.	115 mA
i_f	Recurrent peak forward current	225 mA
i_f (surge)	Peak forward surge current pulse width of 1.0 Second	500 mA
i_f (surge)	Peak forward surge current pulse width of 1.0 μSecond	2000 mA
P	Power dissipation	250 mW
P	Power dissipation at 125° C	100 mW
T_A	Operating temperature	-65° C to +175° C
T_{stg}	Storage temperature, ambient	-65° C to +200° C



ELECTRICAL SPECIFICATIONS (25° C unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
V_F	Forward Voltage	0.700		0.850	Volt	I_F = 10 mA
V_F	Forward Voltage	0.610		0.710	Volt	I_F = 2.0 mA
V_F	Forward Voltage	0.550		0.650	Volt	I_F = 1.0 mA
V_F	Forward Voltage	0.505		0.575	Volt	I_F = 250 μA
I_R	Reverse Current			0.1	μA	V_R = -50 V
I_R	Reverse Current (150° C)			100	μA	V_R = -50 V
BV	Breakdown Voltage	75			Volts	I_R = 5.0 μA
t_{rr}	Reverse Recovery Time [Note 2]			4.0	mμSec	I_f = 10 mA I_r = 10 mA
C_o	Capacitance [Note 3]			2.0	$\mu\mu$f	V_R = 0 V f = 1.0 mc
RE	Rectification Efficiency [Note 4]	45			%	f = 100 mc
ΔV_F/° C	Forward Voltage Temperature Coefficient		-1.8		mV	

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NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 1.0 mA in E. G. and G. circuit.

(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

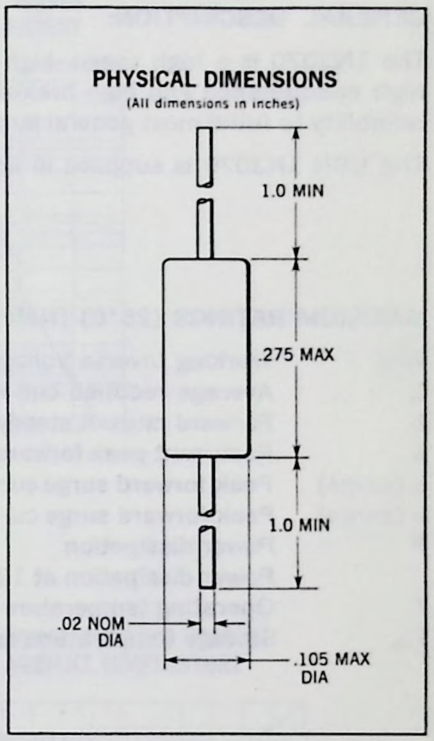
(4) Rectification efficiency is defined as the ratio of D. C. load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V r. m. s. input to the circuit. Load resistance 5.0 K ohms, load capacitance 20 pf.

1N3064

ULTRA FAST—LOW CAPACITANCE PLANAR* DIODE

XIMUM RATINGS (25°C) [Note 1]

IV	Working Inverse Voltage	50 Volts
	Average rectified current	75 mA
	Forward current steady state d.c.	115 mA
	Recurrent peak forward current	225 mA
(surge)	Peak forward surge current pulse width of 1.0 Second	500 mA
(surge)	Peak forward surge current pulse width of 1.0 μSecond	2000 mA
	Power dissipation	250 mW
	Power dissipation at 125°C	100 mW
	Operating temperature	−65°C to +150°C
	Storage temperature, ambient	−65°C to +175°C



CTRICAL SPECIFICATIONS (25°C unless otherwise noted)

MBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
	Forward Voltage			1.0	Volt	$I_F = 10$ mA
	Reverse Current			0.1	μA	$V_R = -50$ V
	Reverse Current (150°C)			100	μA	$V_R = -50$ V
V	Breakdown Voltage	75			Volts	$I_R = 5.0\ \mu$A
	Reverse Recovery Time [Note 2]			4.0	ns	$I_f = 10$ mA $I_r = 10$ mA ($V_r = 1.0$V) $R_L = 100\ \Omega$
	Forward Recovery Peak Voltage [Note 3]			3.0	Volts	$I_f = 100$ mA pulse
	Capacitance [Note 4]			2.0	pF	$V_R = 0$ V f = 1.0 MHz
E	Rectification Efficiency [Note 5]	45			%	f = 100 MHz
/°C	Forward Voltage Temperature Coefficient		−1.8		mV	

*Planar is a patented Fairchild process.

maximum ratings are limiting values above which life or satisfactory performance may be impaired.

very to 1.0 mA in E. G. and G. circuit.

cilloscope used as the response detector shall have a band width of at least 10 MHz (3.0 dB down), and shall be calibrated using a deposited carbon resistor of 50 ohms in the test clips. t_{fr} is defined as the difference between the 10% point of the pulse and the point where V_F is to within 10% of the quiescent value. Pulse condition shall be 0.1 ns at base, 20 ns maximum rise time, repetition rate = 100 KHz maximum.

itance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

fication efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms. input to the circuit. Load resistance 5.0 load capacitance 20 pF.

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1N3070

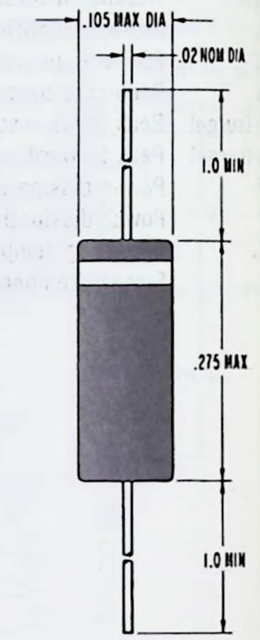
HIGH SPEED, HIGH CONDUCTANCE PLANAR* DIODE

GENERAL DESCRIPTION:

The 1N3070 is a high speed, high conductance, Planar diode. This device couples high speed with high conductance and high breakdown voltage enabling designers to choose a diode with planar reliability to fulfill most general purpose switching applications.

The USN 1N3070 is supplied in accordance with MIL-S-19500/169A.

PHYSICAL DIMENSIONS



NOTE: All dimensions in inches. See note 4

MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	175 V
I_o	Average rectified current	100 mA
I_F	Forward current steady state d.c.	220 mA
i_f	Recurrent peak forward current	300 mA
i_f (surge)	Peak forward surge current pulse width of 1.0 second	1.0 A
i_f (surge)	Peak forward surge current pulse width of 1.0 μSec.	4.0 A
P	Power dissipation	250 mW
	Power dissipation at 125°C	85 mW
T	Operating temperature	−65°C to +175°C
T_{stg}	Storage temperature, ambient	−65°C to +200°C

ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

Symbol	†FACT Subgroup	Characteristic	Min.	Max.	Units	Test Conditions
*V_F	1a	Forward Voltage		1.0	Volt	$I_F = 100$ mA
*I_R	1a	Reverse Current		0.1	μA	$V_R = -175$ V
I_R	1b	Reverse Current (150°C)		100	μA	$V_R = -175$ V
**B_V	1a	Breakdown Voltage	200		Volts	$I_R = 100\ \mu$A
**T_{rr}	1a	Reverse Recovery Time [Note 2]		50	ns	$I_F = 30$ mA, $I_R = 30$ mA, RL = 100 Ω
*C_o	1a	Capacitance		5.0	pf	$V_R = 0$ V, f = 1 MHz
RE	1b	Rectification Efficiency [Note 3]	35		%	f = 100 MHz

† These numerals apply to the FACT program.
* FACT end point, Group B, Subgroup 2, 3, 4, 6, 7.
** FACT end point, Group B, Subgroup 6, 7 only.

* Planar is a patented Fairchild proce

NOTES:

(1) *The maximum ratings are limiting values above which life or satisfactory performance may be impaired.*
(2) *Recovery to 1.0 mA.*
(3) *Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance: 5.0 K ohms, load capacitance 20 pf.*
(4) *Leads are tinned. Gold plate with nickel strike may be obtained when specified.*

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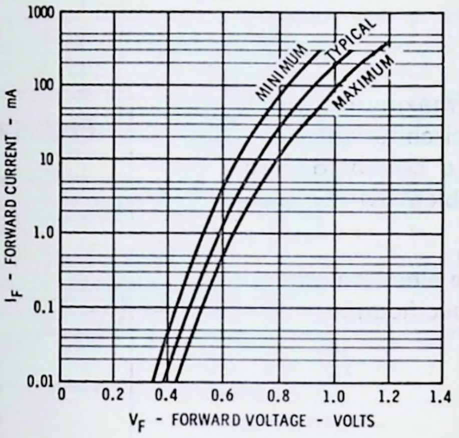
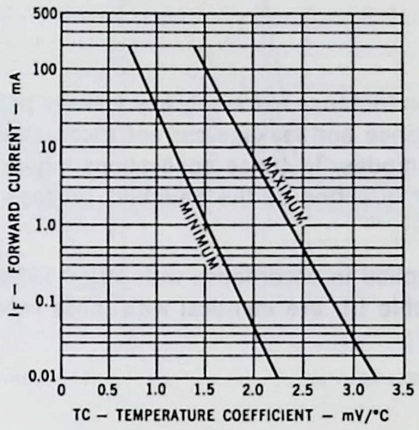
TYPICAL ELECTRICAL CHARACTERISTICS

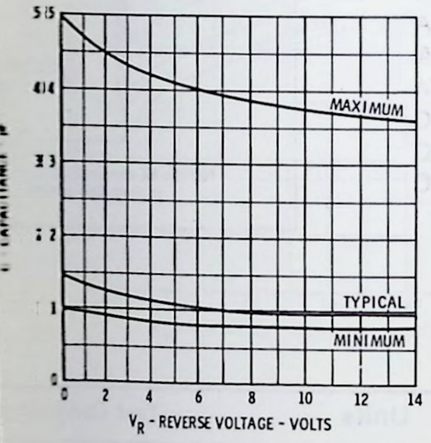
FORWARD VOLTAGE VERSUS FORWARD CURRENT



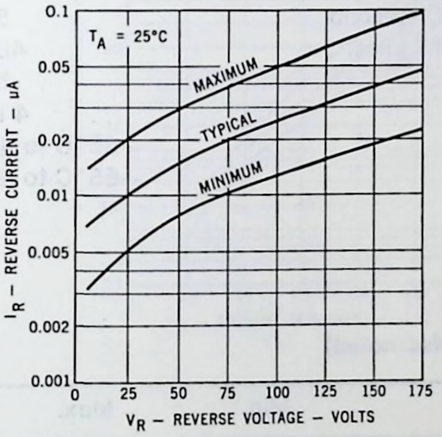
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



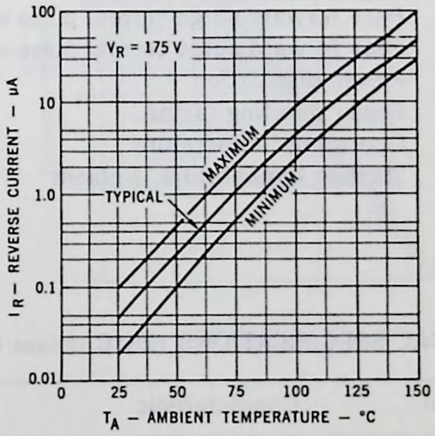
CAPACITANCE VERSUS REVERSE VOLTAGE



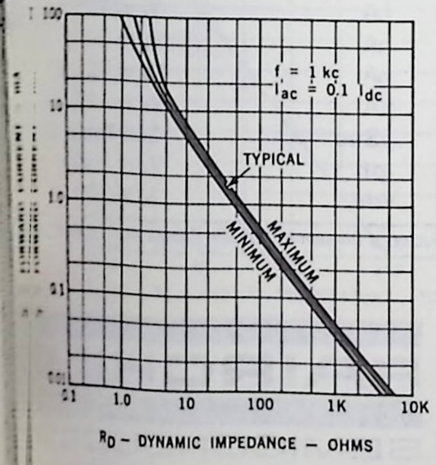
REVERSE VOLTAGE VERSUS REVERSE CURRENT



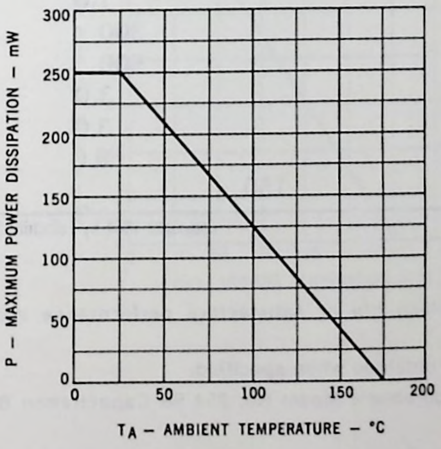
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



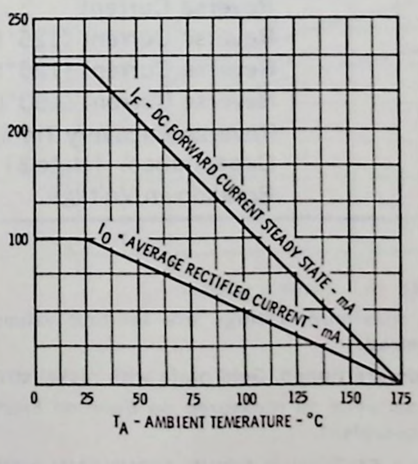
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



POWER DERATING CURVE



FORWARD CURRENT AND AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



1N3595

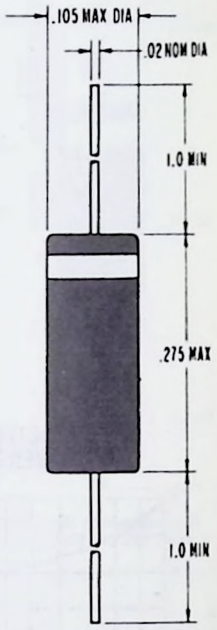
HIGH CONDUCTANCE LOW LEAKAGE PLANAR DIODE

REGISTERED SPECIFICATIONS

The 1N3595 is a high conductance extremely low leakage planar diode. Specified maximum values for voltage drop capacitance and leakage current mean flexibility in designing circuits which require large numbers of diodes. In those applications where reverse current is a critical design parameter, the inherent qualities of the Fairchild process eliminates the problem of leakage degradation.

The USN 1N3595 is supplied in accordance with MIL-S-19500/241A (NAVY). The electrical specifications, as listed in Table III, are identical with those listed in this Military Specification.

PHYSICAL DIMENSIONS



NOTE: All dimensions in inches. See note 2

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	125 V
I_O	Average rectified current	150 mA
I_F	Forward current steady state d.c.	225 mA
i_f	Recurrent peak forward current	450 mA
i_f (surge)	Peak forward surge current pulse width of 1 second	500 mA
i_f (surge)	Peak forward surge current pulse width of 1 μSec.	4000 mA
P	Power dissipation	500 mW
$1/\theta$	Power derating factor	4 mW/°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{F_1}	Forward Voltage	.83	1.00	Vdc	$I_F = 200$ mA
V_{F_2}	Forward Voltage	.79	.92	Vdc	$I_F = 100$ mA
V_{F_3}	Forward Voltage	.74	.88	Vdc	$I_F = 50$ mA
V_{F_4}	Forward Voltage	.65	.80	Vdc	$I_F = 10$ mA
V_{F_5}	Forward Voltage	.60	.75	Vdc	$I_F = 5$ mA
V_{F_6}	Forward Voltage	.52	.68	Vdc	$I_F = 1$ mA
I_{R_1}	Reverse Current		1.0	nA	$V_R = 125$ V
I_{R_2}	Reverse Current (125°C)		300	nA	$V_R = 30$ V
I_{R_3}	Reverse Current (125°C)		500	nA	$V_R = 125$ V
I_{R_4}	Reverse Current (150°C)		3.0	μA	$V_R = 125$ V
t_{rr}	Reverse Recovery Time		3.0	μSec	See Table III
C	Capacitance [Note 3]		8.0	pf	$V_R = 0$ V
BV	Breakdown Voltage	150		Vdc	$I_R = 100\ \mu$A

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NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

(3) Capacitance as measured on Boonton Electronic Corporation's Model No. 75A-S8 Capacitance Bridge or equivalent.

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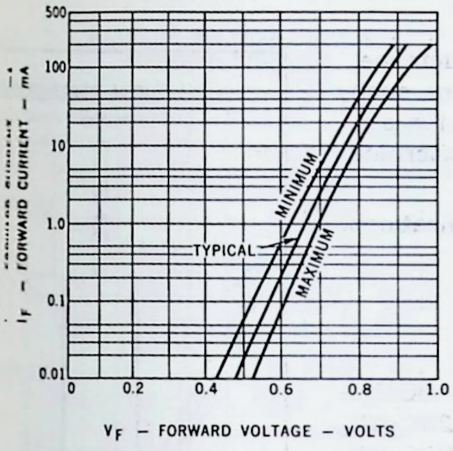
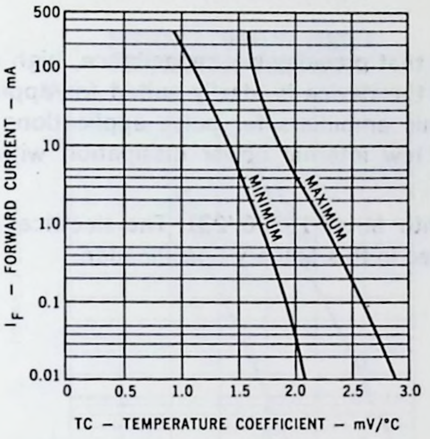
TYPICAL ELECTRICAL CHARACTERISTICS

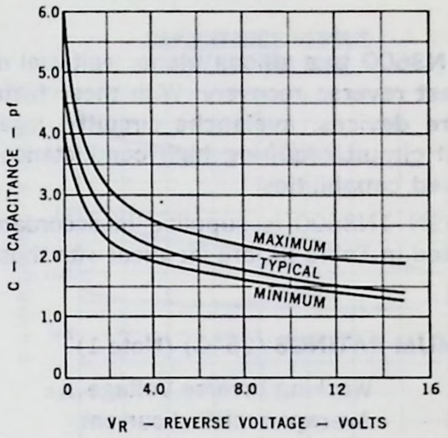
FORWARD VOLTAGE VERSUS FORWARD CURRENT



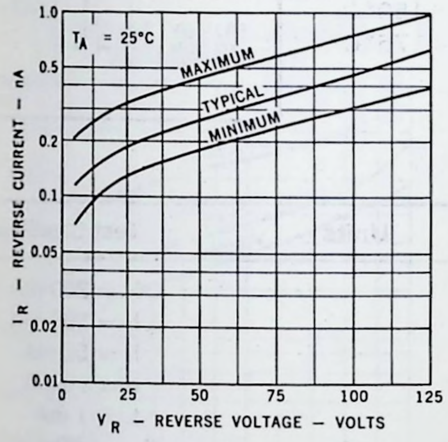
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



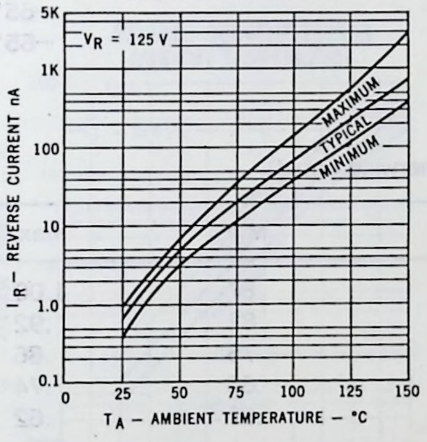
CAPACITANCE VERSUS REVERSE VOLTAGE



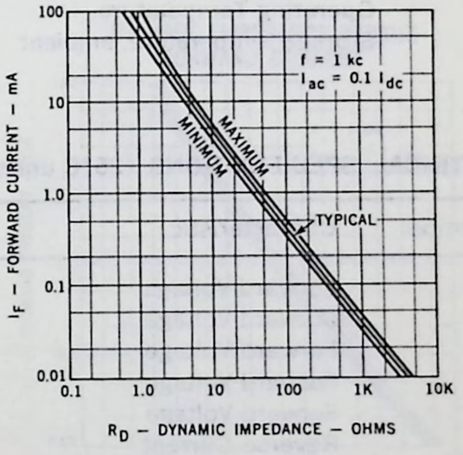
REVERSE VOLTAGE VERSUS REVERSE CURRENT



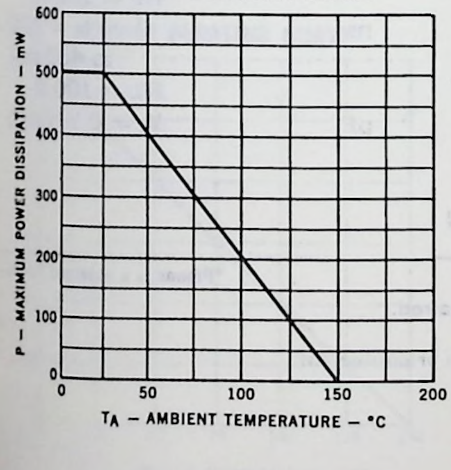
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



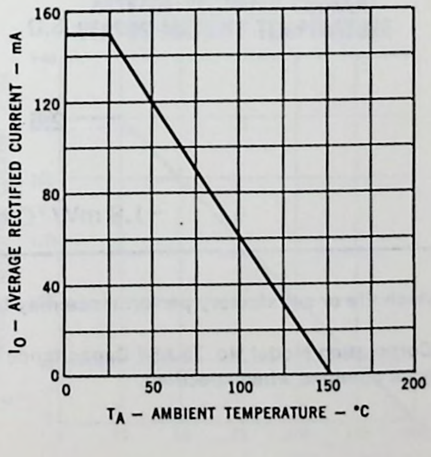
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



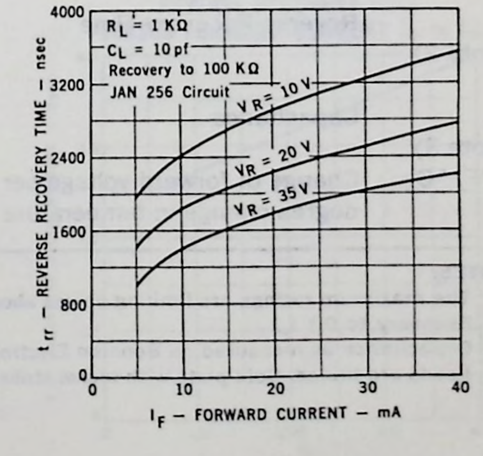
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT AND REVERSE BIAS VOLTAGE



1N3600

HIGH CONDUCTANCE ULTRA FAST EPITAXIAL PLANAR* DIODE

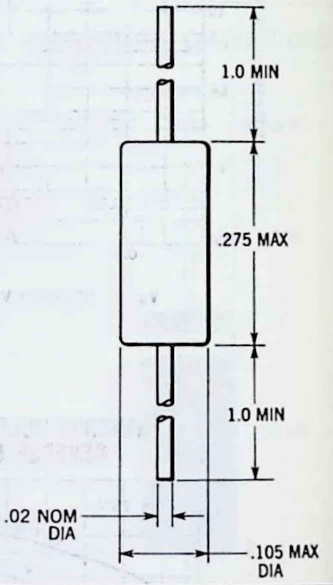
REGISTERED SPECIFICATIONS

The 1N3600 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities.

The USN 1N3600 is supplied in accordance with MIL-S-19500/231. The electrical specifications, as listed in Table III, are identical with those listed in this Military Specification.

PHYSICAL DIMENSIONS

(All dimensions in inches)



MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	50 V
I_O	Average rectified current	200 mA
i_f	Recurrent peak forward current	900 mA
i_f (surge)	Peak forward surge current pulse width of 1 second	1 A
i_f (surge)	Peak forward surge current pulse width of 1 μs	4 A
P	Power dissipation	500 mW
P	Power dissipation	170 mW @ 125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage	.87	1.00		$I_F = 200$ mA
V_F	Forward Voltage	.82	.92		$I_F = 100$ mA
V_F	Forward Voltage	.76	.86		$I_F = 50$ mA
V_F	Forward Voltage	.66	.74		$I_F = 10$ mA
V_F	Forward Voltage	.54	.62		$I_F = 1$ mA
I_R	Reverse Current		0.1	μA	$V_R = -50$ V
I_R	Reverse Current (150°C)		100	μA	$V_R = -50$ V
BV	Breakdown Voltage	75			$I_R = 5\ \mu$A
t_{rr} (note 2)	Reverse Recovery Time		4.0	ns	$I_F = I_R = 10$ mA to 200 mA RL = 100 Ω
t_{rr} (note 2)	Reverse Recovery Time		6.0	ns	$I_F = I_R = 200$ mA to 400 mA RL = 100 Ω
C_O (note 3)	Capacitance		2.5	pF	$V_R = 0$ V, f = 1 MHz
ΔVF/°C	Change of forward voltage per degree change in temperature	−1.8 mV/°C typical			

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 0.1 I_F.

(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

*Planar is a patented Fairchild proce

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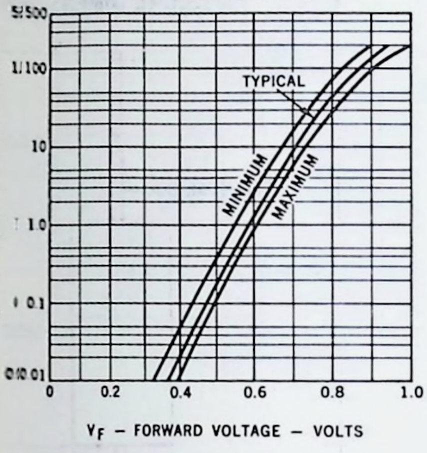
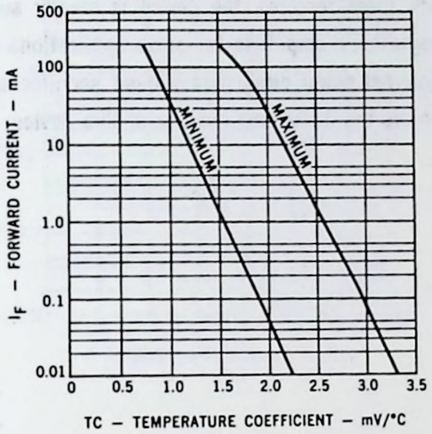
TYPICAL ELECTRICAL CHARACTERISTICS

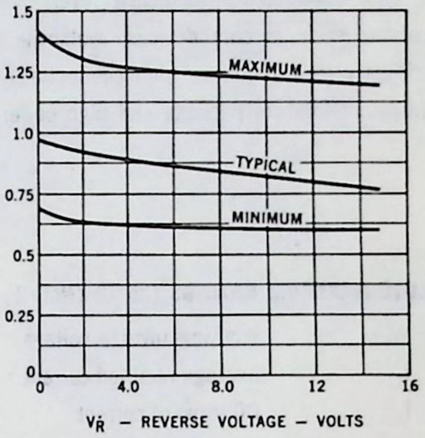
FORWARD VOLTAGE VERSUS FORWARD CURRENT



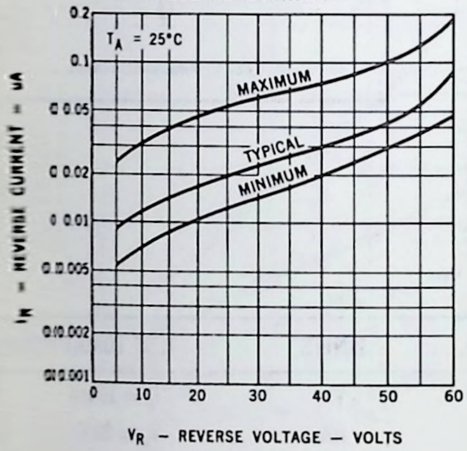
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



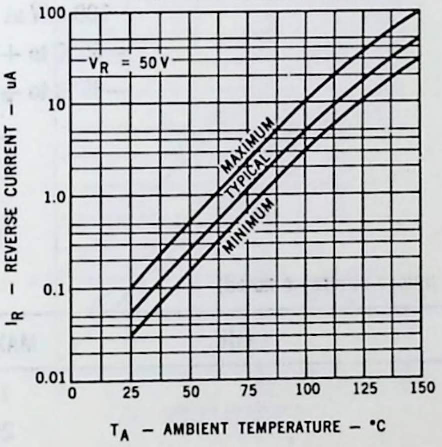
CAPACITANCE VERSUS REVERSE VOLTAGE



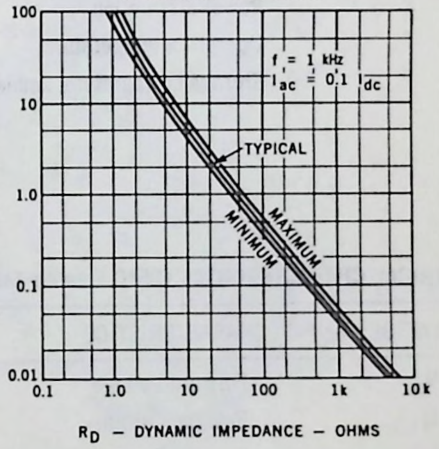
REVERSE VOLTAGE VERSUS REVERSE CURRENT



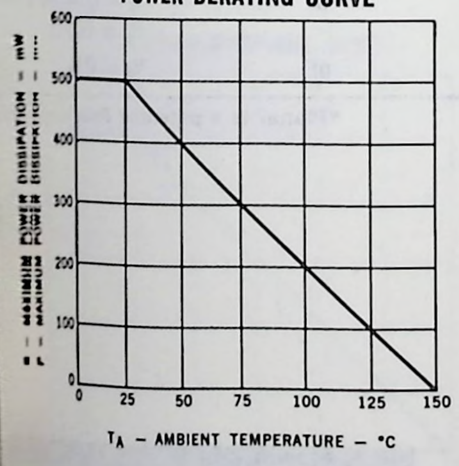
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



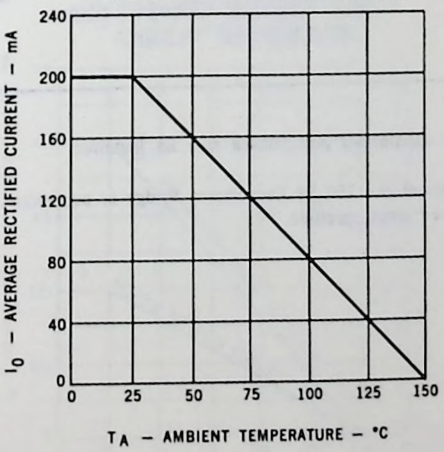
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



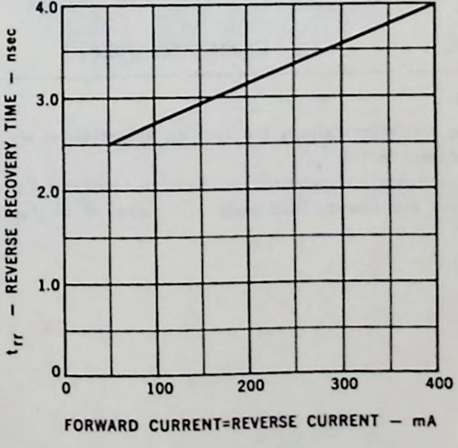
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

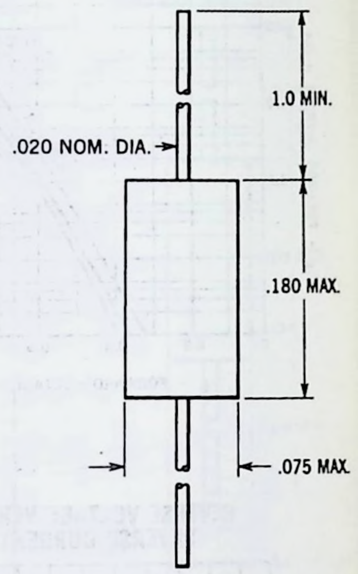


1N4148

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST, PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4148 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working inverse voltage	75V
I_O	Average rectified current	200 mA
I_F	DC forward current	400 mA
i_f	Recurrent peak forward current	600 mA
i_f(surge)	Peak forward surge current pulse width of 1 second	1 A
i_f(surge)	Peak forward surge current pulse width of 1 μs	4 A
P	Power dissipation	500 mW
P	Power dissipation	100 mW at 125°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_F = 10$ mA
I_{R1}	Reverse Current		250	nA	$V_R = 20$ V
I_{R2}	Reverse Current (150°C)		50	μA	$V_R = 20$ V
BV	Breakdown Voltage	75		V	$I_R = 5\ \mu$A
BV	Breakdown Voltage	100		V	$I_R = 100\ \mu$A
T_{RR}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$ mA $R_L = 100\ \Omega$
C	Capacitance (Note 3)		4.0	pF	$V_R = 0$ V

*Planar is a patented Fairchild proc

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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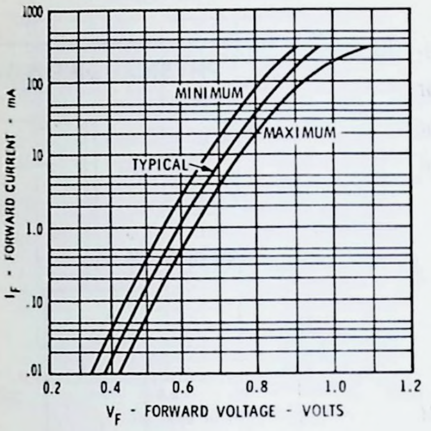
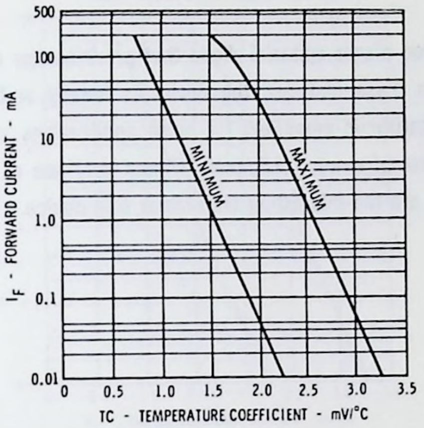
TYPICAL ELECTRICAL CHARACTERISTICS

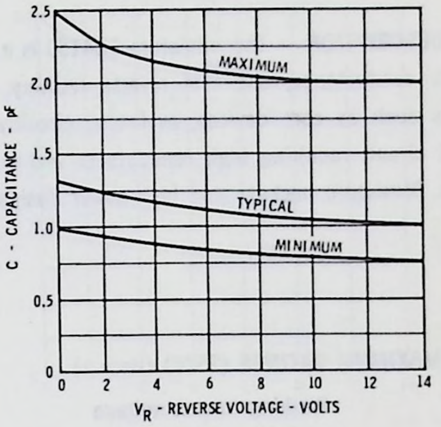
FORWARD VOLTAGE VERSUS FORWARD CURRENT



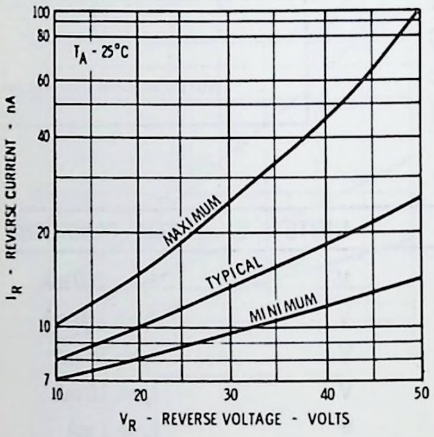
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



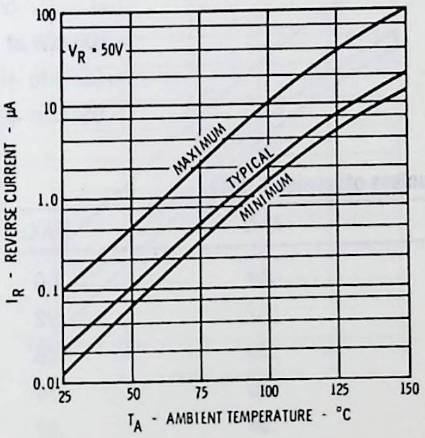
CAPACITANCE VERSUS REVERSE VOLTAGE



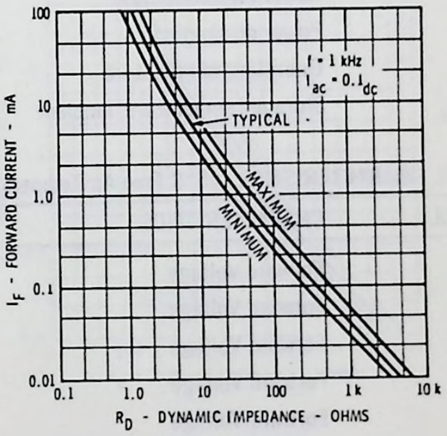
REVERSE CURRENT VERSUS REVERSE VOLTAGE



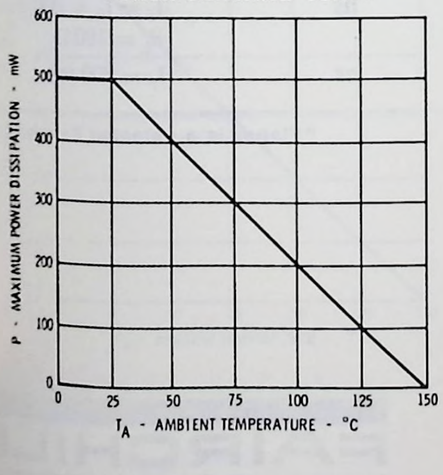
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



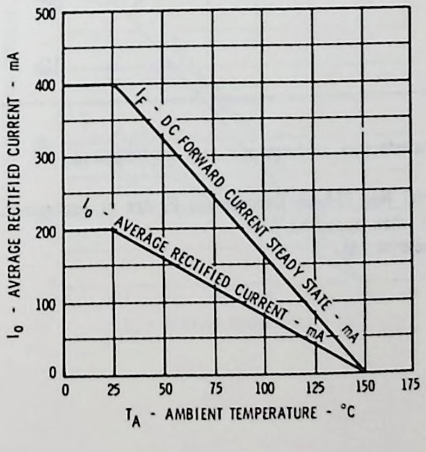
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



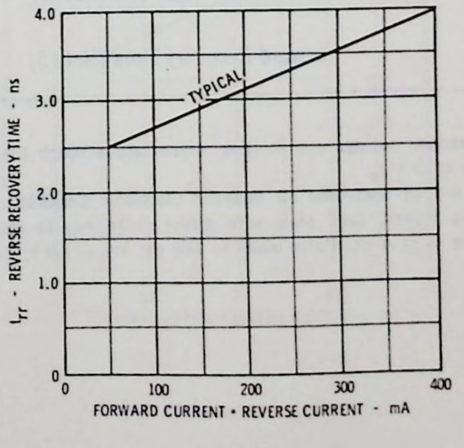
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

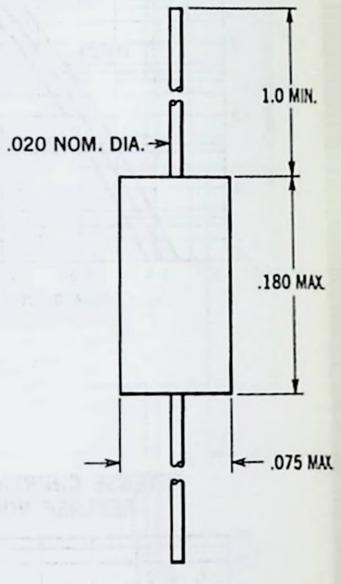


1N4150

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST, PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4150 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working inverse voltage	50 V
I_O	Average rectified current	200 mA
I_F	DC forward current	400 mA
i_f	Recurrent peak forward current	600 mA
i_f(surge)	Peak forward surge current pulse width of 1 second	1 A
i_f(surge)	Peak forward surge current pulse width of 1 μs	4 A
P	Power dissipation	500 mW
P	Power dissipation	100 mW at 125°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage	.87	1.0	V	$I_F = 200$ mA
V_{F2}	Forward Voltage	.82	.92	V	$I_F = 100$ mA
V_{F3}	Forward Voltage	.76	.86	V	$I_F = 50$ mA
V_{F4}	Forward Voltage	.66	.74	V	$I_F = 10$ mA
V_{F5}	Forward Voltage	.54	.62	V	$I_F = 1$ mA
I_{R1}	Reverse Current		100	nA	$V_R = 50$ V
I_{R2}	Reverse Current (+150°C)		100	μA	$V_R = 50$ V
C	Capacitance (Note 3)		2.5	pF	$V_R = 0$ V
T_{RR}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10\text{-}200$ mA $R_L = 100\ \Omega$
T_{RR}	Reverse Recovery Time (Note 2)		6	ns	$I_F = I_R = 200\text{-}400$ mA $R_L = 100\ \Omega$
T_{FR}	Forward Recovery Time (Note 5)		10	ns	$I_F = 200$ mA

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.
(5) Rise time = $\leq$.4 ns; Pulse width = 100 ns; $V_{FR} = 1.0$ V; Duty cycle = 1%.

*Planar is a patented Fairchild proc

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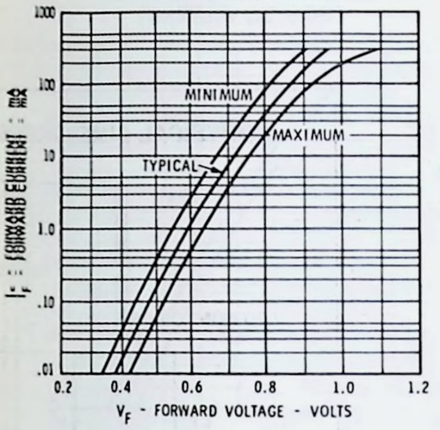
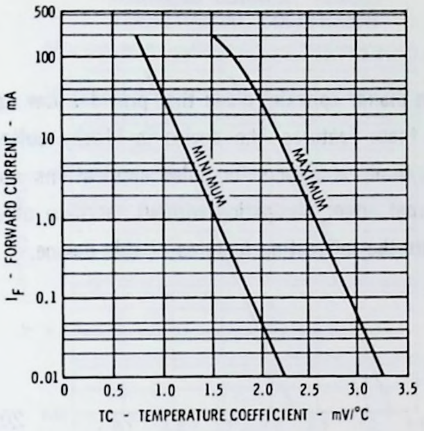
FAIRCHILD DIODE 1N4150

TYPICAL ELECTRICAL CHARACTERISTICS

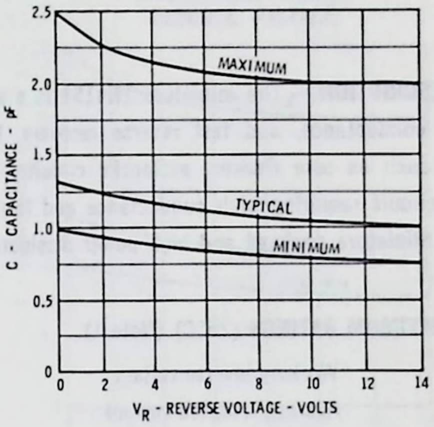
FORWARD VOLTAGE VERSUS FORWARD CURRENT



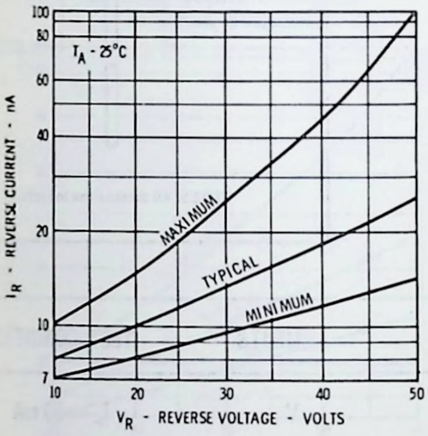
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



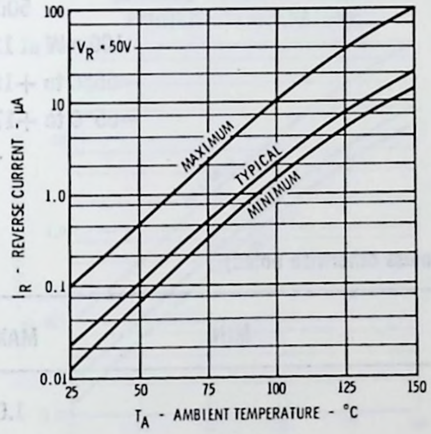
CAPACITANCE VERSUS REVERSE VOLTAGE



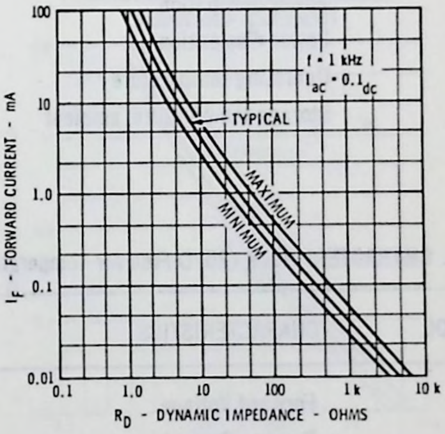
REVERSE CURRENT VERSUS REVERSE VOLTAGE



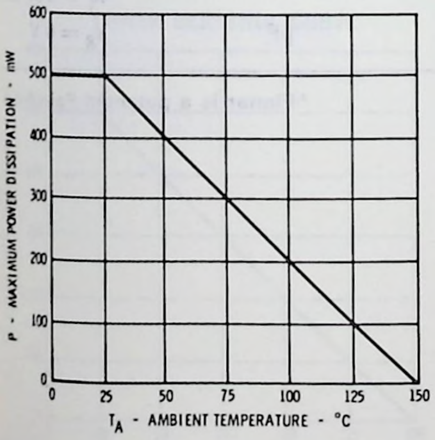
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



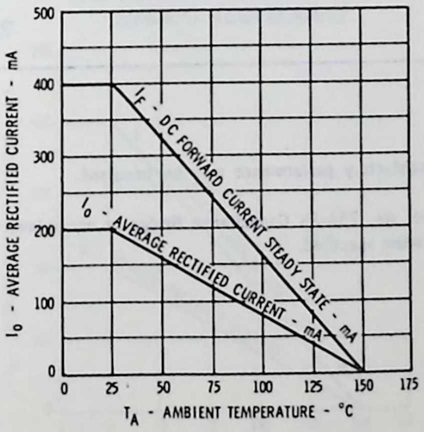
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



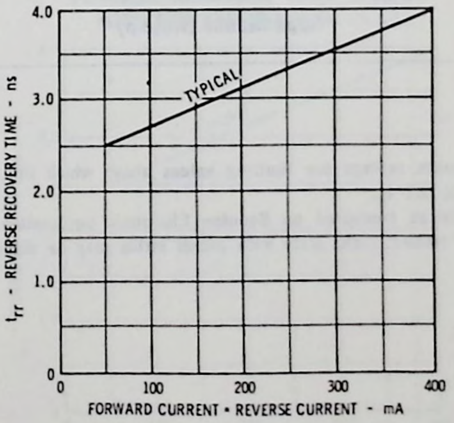
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

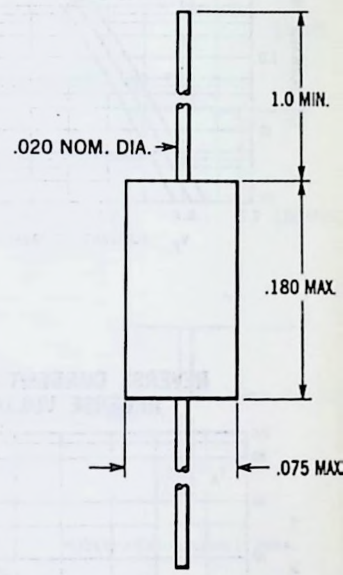


1N4151

MINIATURE SIZE, HIGH CONDUCTANCE
ULTRA FAST, PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4151 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working inverse voltage	50 V
I_O	Average rectified current	200 mA
I_F	DC forward current	400 mA
i_f	Recurrent peak forward current	600 mA
i_f (surge)	Peak forward surge current, pulse width of 1 sec	1 A
i_f (surge)	Peak forward surge current pulse width of 1 μs	4 A
P	Power dissipation	500 mW
P	Power dissipation	100 mW at 125°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_F = 50$ mA
I_{R1}	Reverse Current		50	nA	$V_R = 50$ V
I_{R2}	Reverse Current (+150°C)		50	μA	$V_R = 50$ V
BV	Breakdown Voltage	75		V	$I_R = 5$ μA
T_{RR}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$ mA $R_L = 100\ \Omega$
C	Capacitance (Note 3)		2.0	pF	$V_R = 0$ V

*Planar is a patented Fairchild proc

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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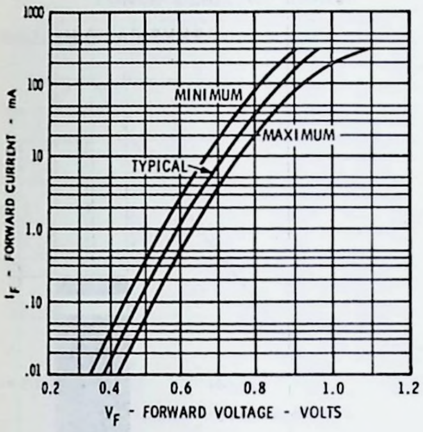
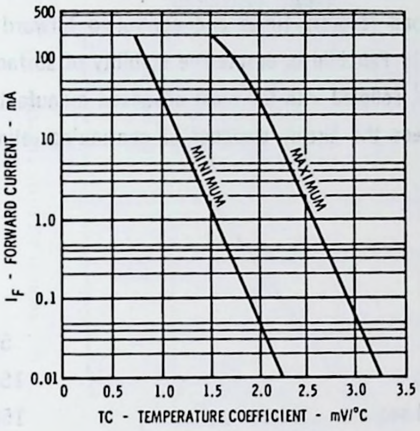
FAIRCHILD DIODE 1N4151

TYPICAL ELECTRICAL CHARACTERISTICS

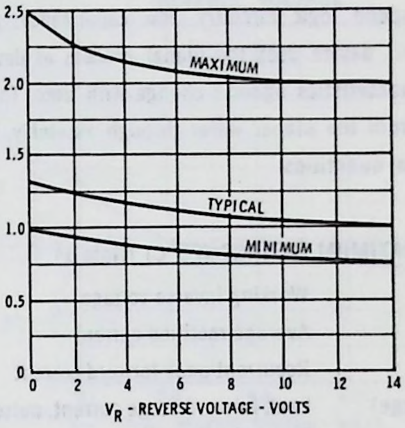
FORWARD VOLTAGE VERSUS FORWARD CURRENT



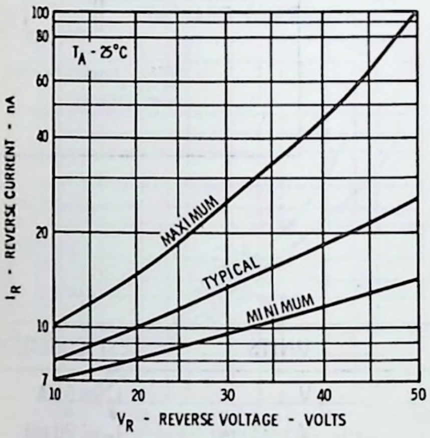
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



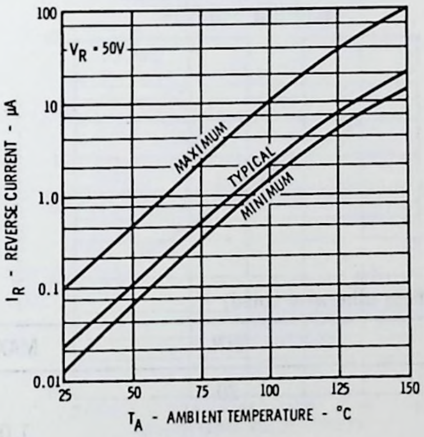
CAPACITANCE VERSUS REVERSE VOLTAGE



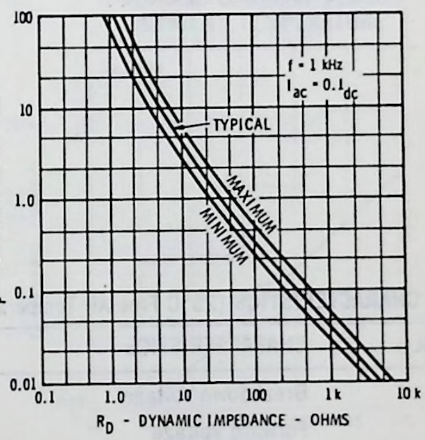
REVERSE CURRENT VERSUS REVERSE VOLTAGE



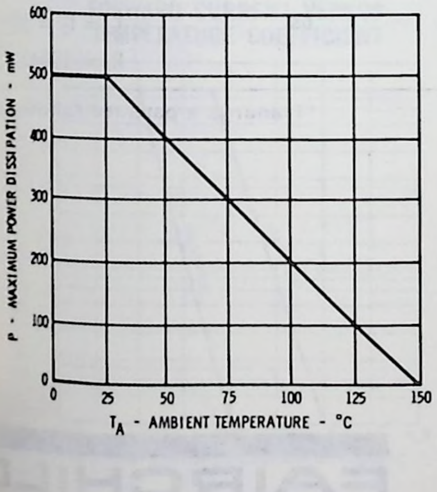
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



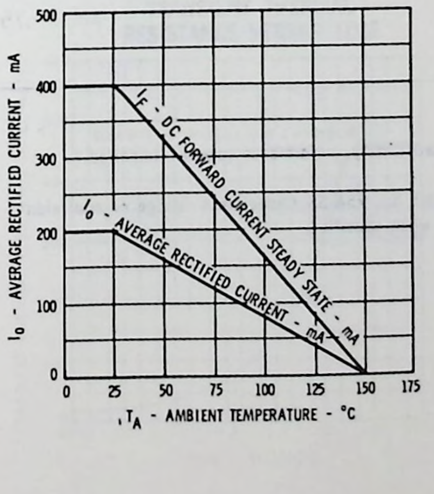
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



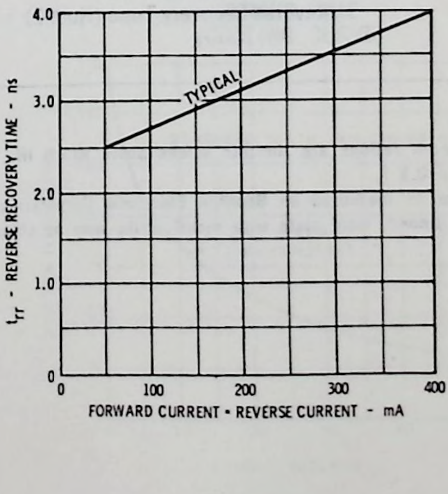
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



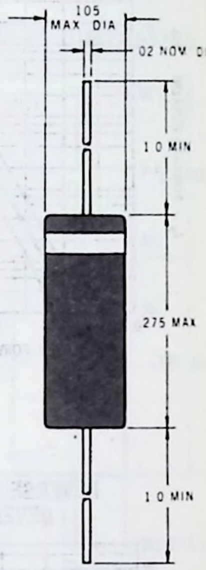
REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)



1N4244
PICO-SECOND COMPUTER DIODE

GENERAL DESCRIPTION — The 1N4244 is a silicon planar* epitaxial diode providing features necessary for ultra high speed logic circuitry: low capacitance, pico-second recovery times and controlled forward conductance. This device uses the planar process as developed by Fairchild to ensure the stability of surface dependent characteristics against change with time. This factor, coupled with the most advanced manufacturing techniques from the planar wafer through assembly, guarantees the circuit designer of continuing reliability in production quantities.

PHYSICAL DIMENSIONS



NOTE: All dimensions in inches
See note 4.
Weight: 0.25 gram.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working inverse voltage	10 V
I_O	Average rectified current	50 mA
i_f	Recurrent peak forward current	150 mA
i_f (surge)	Peak forward surge current, pulse width 1 sec	150 mA
P	Power dissipation	250 mW
$1/\theta$	Power derating factor	2 mW/°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +150°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	20		V	$I_R = 5\ \mu A$
V_F	Forward Voltage		1.0	V	$I_F = 20$ mA
I_{R1}	Reverse Current		100	nA	$V_R = 10$ V
I_{R2}	Reverse Current		250	nA	$V_R = 15$ V
I_{R3}	Reverse Current (+150°C)		100	μA	$V_R = 10$ V
C	Capacitance (Note 3)		0.8	pF	$V_R = 0$ V,
T_{RR}	Reverse Recovery Time (Note 2)		.75	ns	$I_F = I_R = 10$ mA $R_L = 100\ \Omega$

*Planar is a patented Fairchild proc

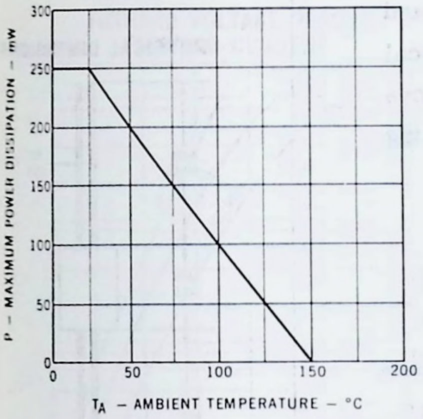
NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_F.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

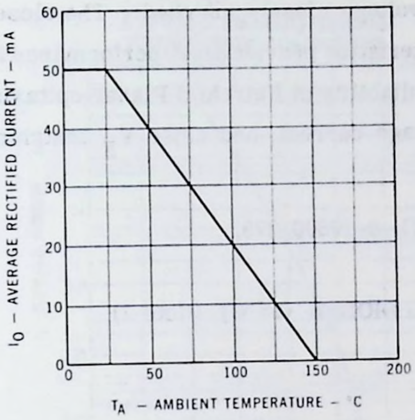
FAIRCHILD DIODE 1N4244

TYPICAL ELECTRICAL CHARACTERISTICS

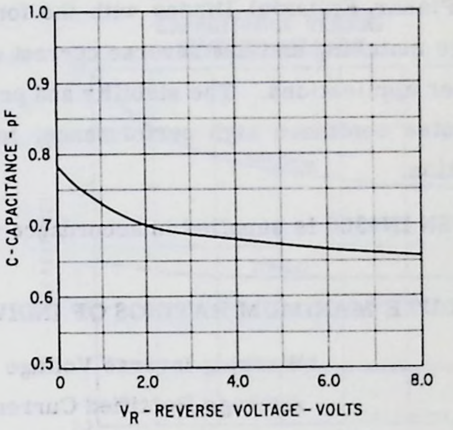
POWER DERATING CURVE



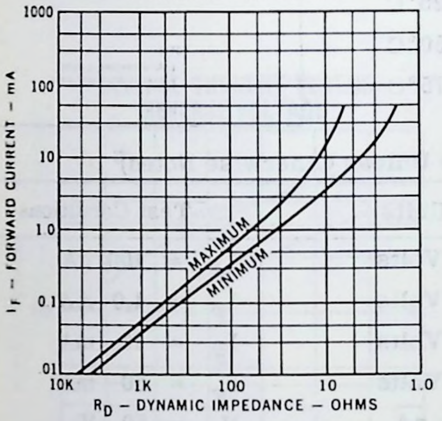
AVERAGE RECTIFIED CURRENT DERATING CURVE



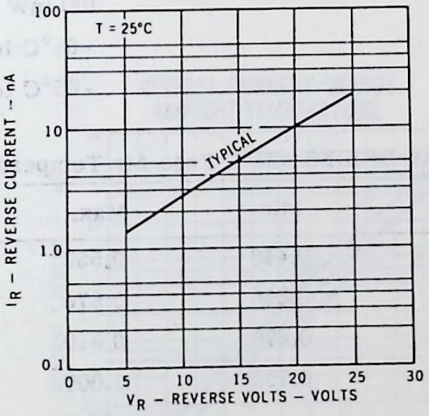
CAPACITANCE VERSUS REVERSE VOLTAGE



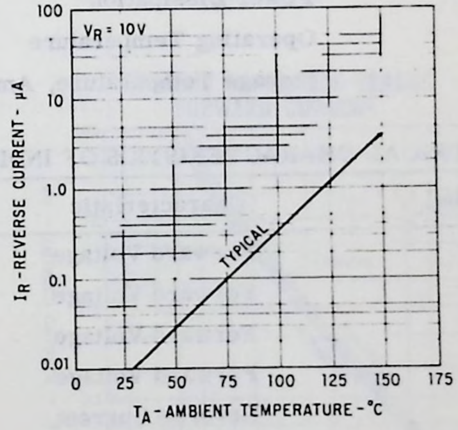
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



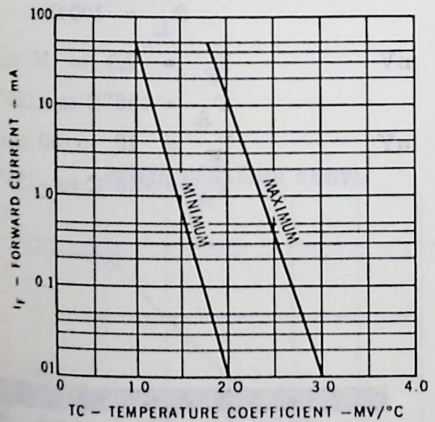
REVERSE VOLTAGE VERSUS REVERSE CURRENT



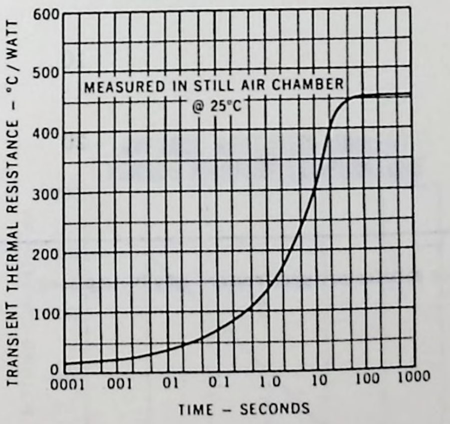
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



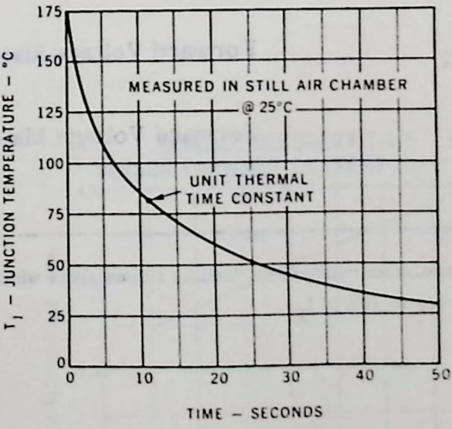
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



TRANSIENT THERMAL RESISTANCE VERSUS TIME



JUNCTION TEMPERATURE VERSUS TIME (COOLING CURVE)



USN1N4306 • 1N4306

MATCHED PAIR, HIGH CONDUCTANCE ULTRA FAST PLANAR EPITAXIAL DIODES

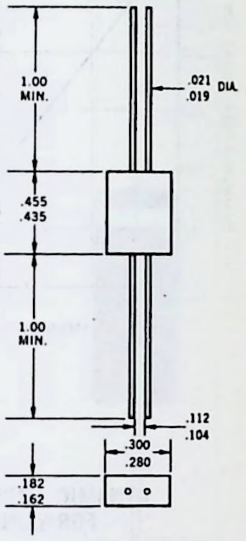
GENERAL DESCRIPTION - The USN 1N4306 (1N4306) consists of two High-Conductance Ultra-Fast Planar Epitaxial Diodes with the forward voltage closely matched. The close forward voltage matching and low reverse current characteristics provide ideal performance in critical chopper applications. The stability and proven reliability of Fairchild Planar epitaxial devices guarantee continued high performance, low leakage current, and close V_F matching during operation.

The USN 1N4306 is supplied in accordance with MIL-S-19500/278.

ABSOLUTE MAXIMUM RATINGS OF INDIVIDUAL DIODES (25°C) (Note 1)

WIV	Working Inverse Voltage	50 Volts
I_o	Average Rectified Current	200 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 sec	1.0 Amp
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μsec	4.0 Amp
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

PHYSICAL DIMENSIONS



NOTES
1. All dimensions in inches.
2. Leads shall be gold plated.

ELECTRICAL CHARACTERISTICS OF INDIVIDUAL DIODES (25°C Free Air Temperature Unless Otherwise Noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{F1}	Forward Voltage	0.440	0.550	Volts	I_F = 100 μA
V_{F2}	Forward Voltage	0.560	0.670	Volts	I_F = 1.0 mA
V_{F3}	Forward Voltage	0.670	0.810	Volts	I_F = 10 mA
V_{F4}	Forward Voltage	0.750	1.000	Volts	I_F = 50 mA
I_{R1}	Reverse Current		50.0	nA	V_R = -50 V
I_{R2}	Reverse Current		5.0	μA	V_R = -75 V
I_{R3}	Reverse Current (150°C)		50.0	μA	V_R = -50 V
C	Capacitance		2.0	pf	V_R = 0, f = 1 Mc
t_{rr} (Note 2)	Reverse Recovery Time		4.0	nsec	I_F = I_R = 10 to 200 m R_L = 100 Ω
ΔV_{F1}	Forward Voltage Match		10	mV	I_F = 0.1 to 10 mA, T_A = -55°C to +125°C
ΔV_{F2}	Forward Voltage Match		20	mV	I_F = 10 to 50 mA, T_A = -55°C to +125°C

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 10% of I_F.

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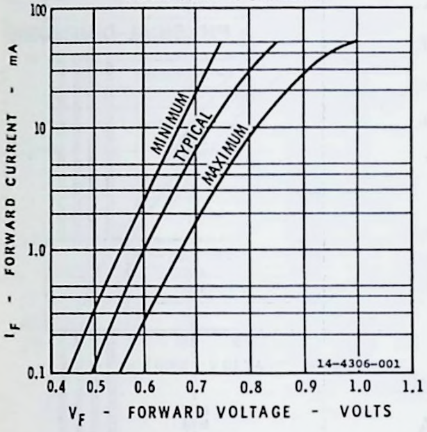
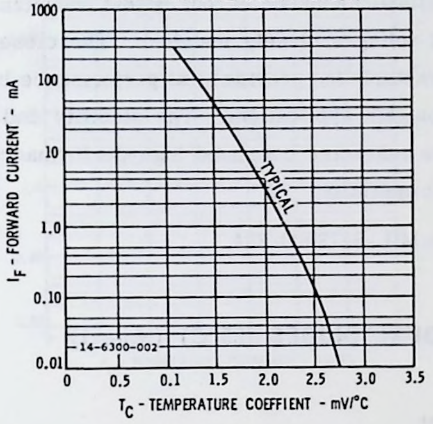
TYPICAL ELECTRICAL CHARACTERISTICS

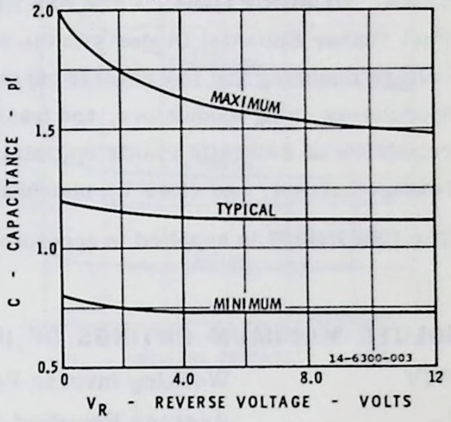
FORWARD VOLTAGE VERSUS FORWARD CURRENT



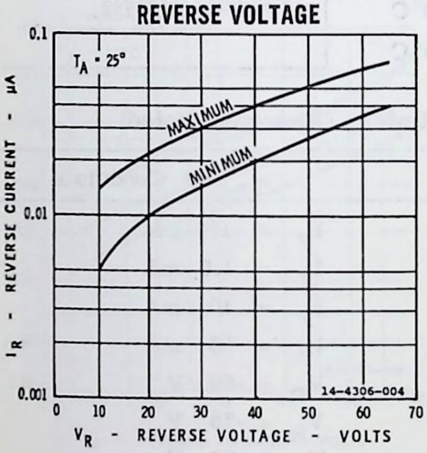
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



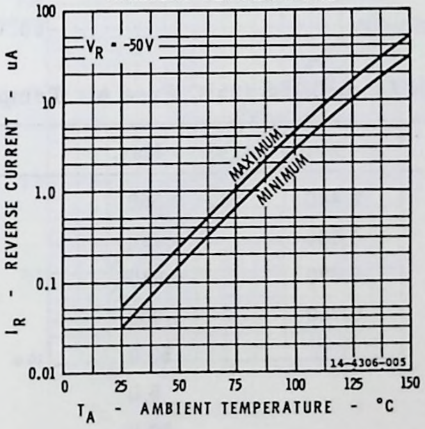
CAPACITANCE VERSUS REVERSE VOLTAGE



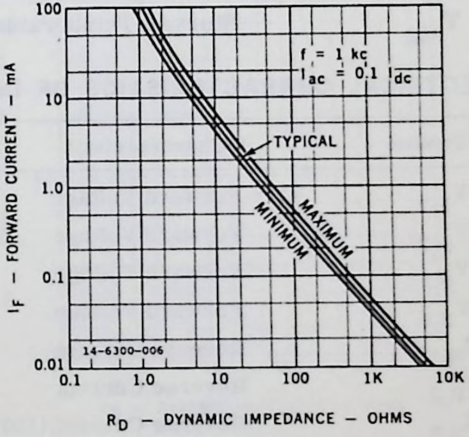
REVERSE CURRENT VERSUS REVERSE VOLTAGE



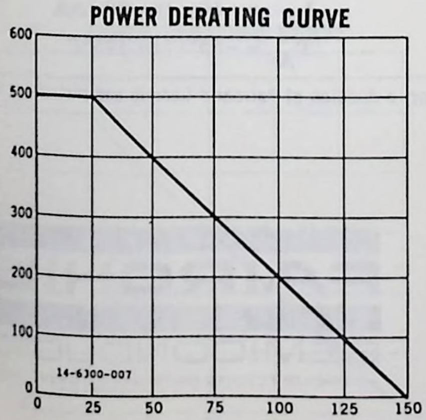
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



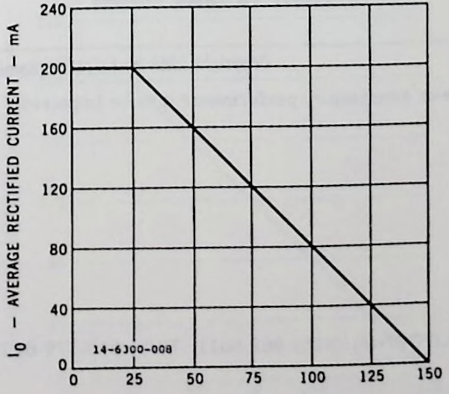
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



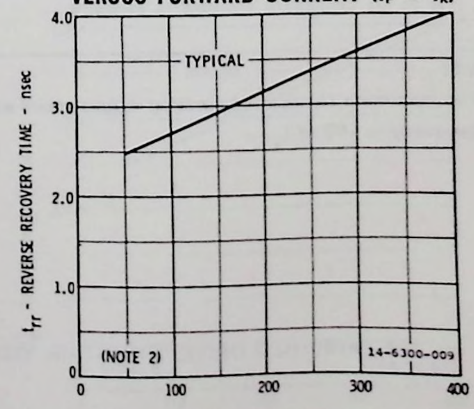
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)



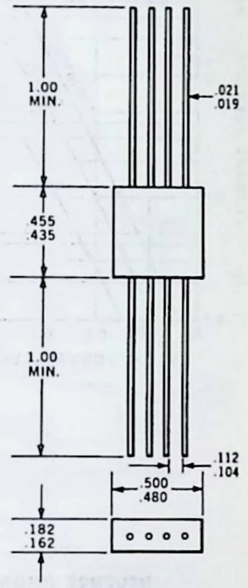
USN1N4307 • 1N4307

MATCHED QUAD, HIGH CONDUCTANCE ULTRA FAST PLANAR EPITAXIAL DIODES

GENERAL DESCRIPTION - The USN 1N4307 (1N4307) consists of four High-Conductance Ultra-Fast Planar Epitaxial Diodes with the forward voltages closely matched. The close forward voltage matching and low reverse current characteristics provide ideal performance in bridge modulators, ring modulators, and transmission gate applications. The stability and proven reliability of Fairchild Planar epitaxial devices guarantee continued high-performance, low-leakage current, and close V_F matching during operation.

The USN 1N4307 is supplied in accordance with MIL-S-19500/284.

PHYSICAL DIMENSIONS



NOTES
1. All dimensions in inches
2. Leads shall be gold plated

ABSOLUTE MAXIMUM RATINGS OF INDIVIDUAL DIODES (25°C) (Note 1)

WIV	Working Inverse Voltage	50 Volts
I_o	Average Rectified Current	200 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 sec	1.0 Amp
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μsec	4.0 Amp
P	Power Dissipation	500 mW
P	Power Dissipation	170 mW at 125°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS OF INDIVIDUAL DIODES (25°C Free Air Temperature Unless Otherwise Noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{F1}	Forward Voltage	0.440	0.550	V	I_F = 100 μA
V_{F2}	Forward Voltage	0.560	0.670	V	I_F = 1.0 mA
V_{F3}	Forward Voltage	0.670	0.810	V	I_F = 10 mA
V_{F4}	Forward Voltage	0.750	1.000	V	I_F = 50 mA
I_{R1}	Reverse Current		50.0	nA	V_R = -50 V
I_{R2}	Reverse Current		5.0	μA	V_R = -75 V
I_{R3}	Reverse Current (150°C)		50.0	μA	V_R = -50 V
C	Capacitance		2.0	pf	V_R = 0 , f = 1 Mc
t_{rr} (Note 2)	Reverse Recovery Time		4.0	nsec	I_F = I_R = 10 mA to 200 m R_L = 100 Ω
ΔV_{F1}	Forward Voltage Match		10	mV	I_F = 0.1 to 10 mA T_A = -55°C to 125°C
ΔV_{F2}	Forward Voltage Match		20	mV	I_F = 10 to 50 mA T_A = -55°C to 125°C

NOTES:

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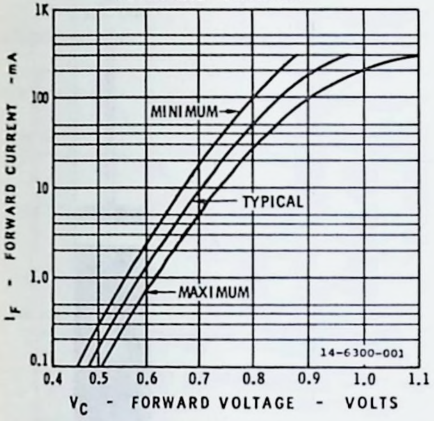
(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

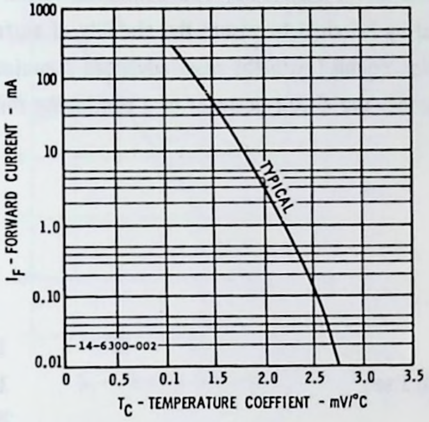
(2) Recovery to 10% of I_F.

TYPICAL ELECTRICAL CHARACTERISTICS

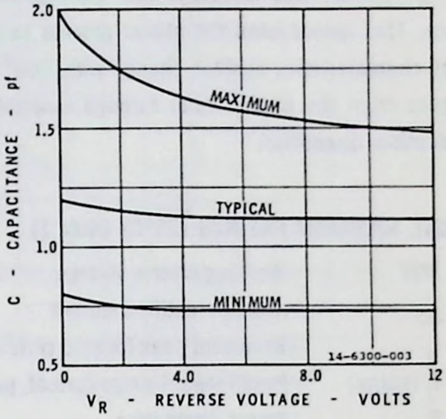
FORWARD VOLTAGE VERSUS FORWARD CURRENT



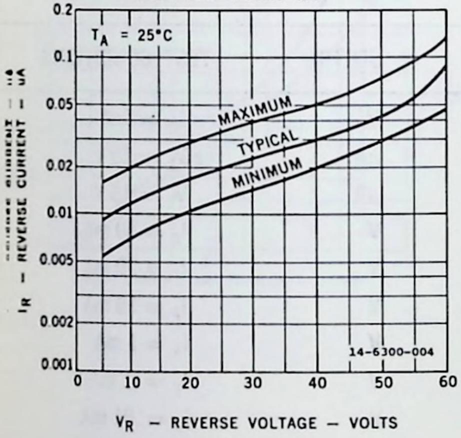
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



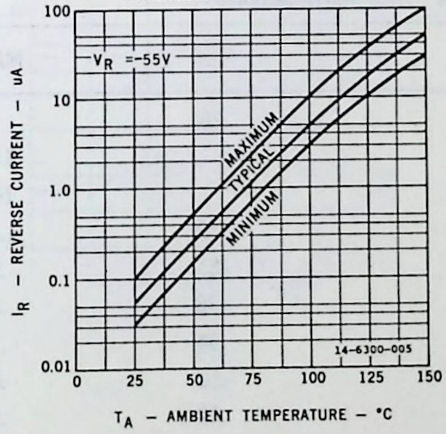
CAPACITANCE VERSUS REVERSE VOLTAGE



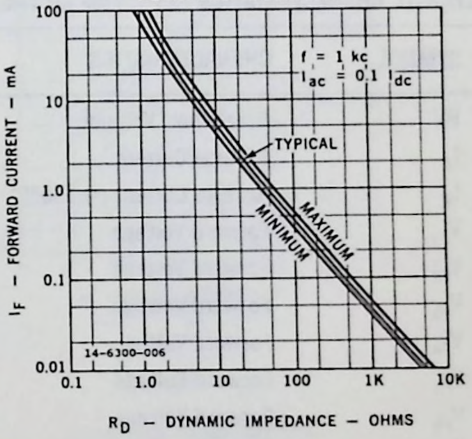
REVERSE VOLTAGE VERSUS REVERSE CURRENT



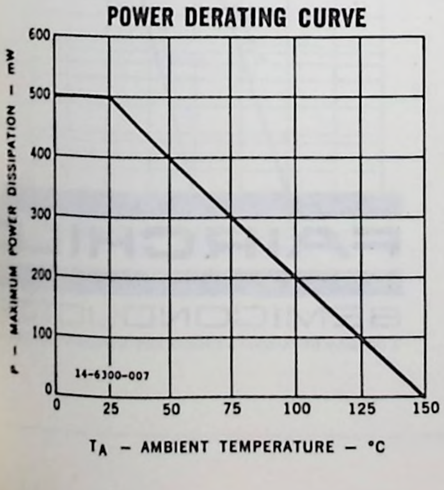
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



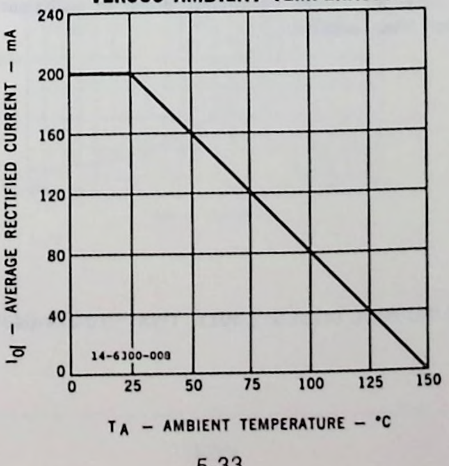
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



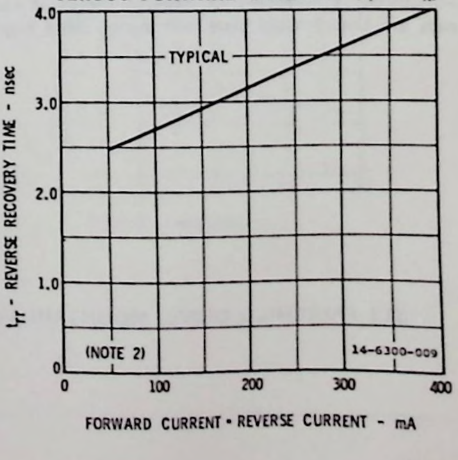
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

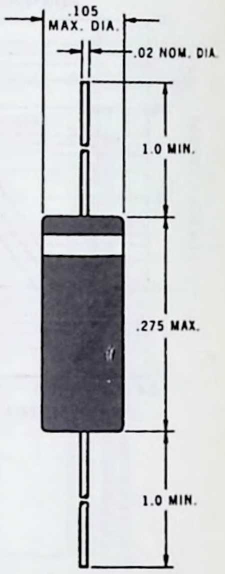


1N4376

PICO-SECOND COMPUTER DIODE

GENERAL DESCRIPTION — The 1N4376 is a silicon planar* epitaxial diode providing features necessary for ultra high speed logic circuitry: low capacitance, pico-second recovery times and controlled forward conductance. This device uses the planar process as developed by Fairchild to ensure the stability of surface-dependent characteristics against change with time. This factor, coupled with the most advanced manufacturing techniques from the planar wafer through assembly, guarantees the circuit designer of a continuing reliability in production quantities.

PHYSICAL DIMENSIONS



NOTE: All dimensions in inches
See note 4.
Weight: 0.25 gram.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working inverse voltage	10 V
I_O	Average rectified current	50 mA
i_f	Recurrent peak forward current	150 mA
i_f (surge)	Peak forward surge current, pulse width 1 sec	150 mA
P	Power dissipation	250 mW
$1/\theta$	Power derating factor	2 mW/°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	20		V	$I_R = 5\mu A$
I_R	Reverse Current		100	nA	$V_R = 10$ V
I_R	Reverse Current (+150°C)		100	μA	$V_R = 10$ V
V_{F1}	Forward Voltage	.89	1.10	V	$I_F = 50$ mA
V_{F2}	Forward Voltage	.81	.95	V	$I_F = 20$ mA
V_{F3}	Forward Voltage	.76	.88	V	$I_F = 10$ mA
V_{F4}	Forward Voltage	.64	.74	V	$I_F = 1$ mA
V_{F5}	Forward Voltage	.52	.61	V	$I_F = .1$ mA
V_{F6}	Forward Voltage	.42	.50	V	$I_F = .01$ mA
T_{RR}	Reverse Recovery Time (Note 2)		750	ps	$I_F = I_R = 10$ mA $R_L = 100\,\Omega$
C	Capacitance (Note 3)		1.0	pF	$V_R = 0$ V, f = 1 MHz

*Planar is a patented Fairchild proc

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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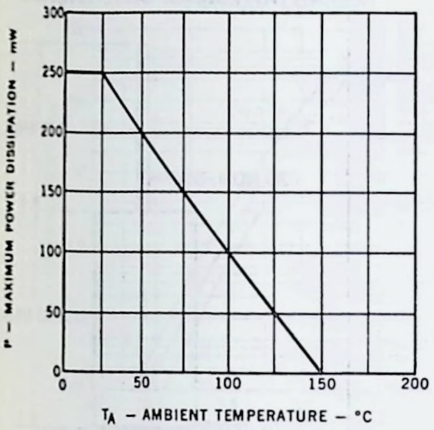
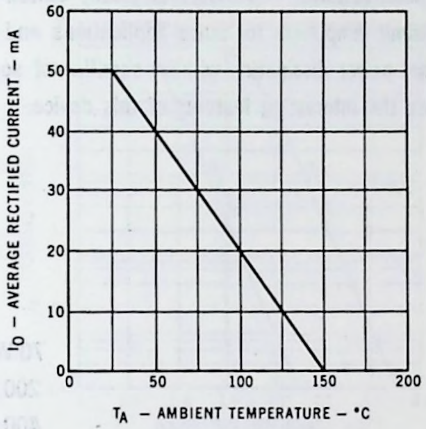
FAIRCHILD DIODE 1N4376

TYPICAL ELECTRICAL CHARACTERISTICS

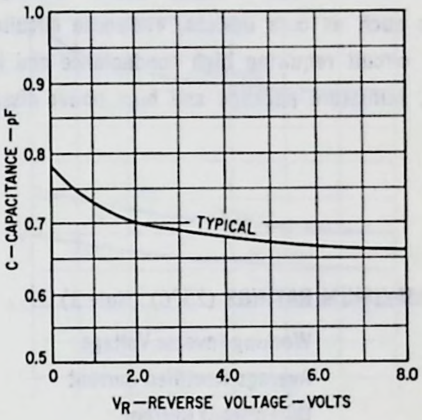
POWER DERATING CURVE



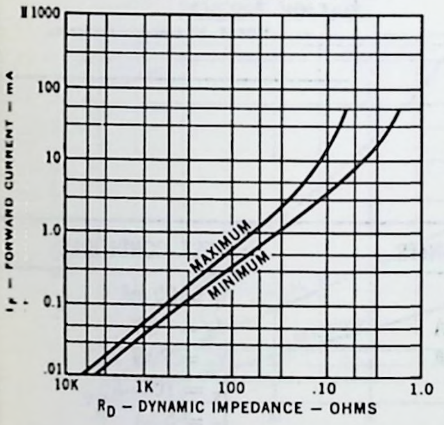
AVERAGE RECTIFIED CURRENT DERATING CURVE



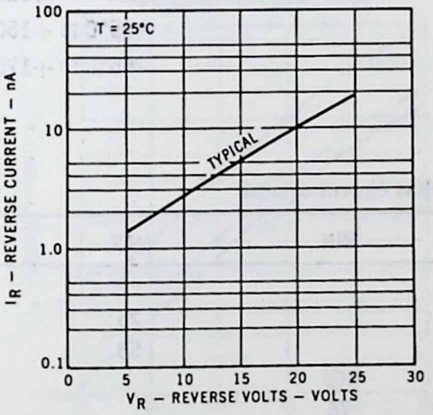
CAPACITANCE VERSUS REVERSE VOLTAGE



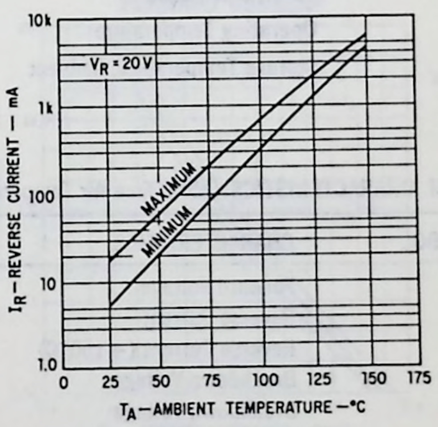
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



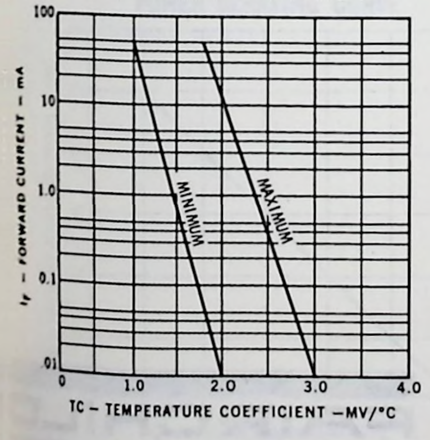
REVERSE VOLTAGE VERSUS REVERSE CURRENT



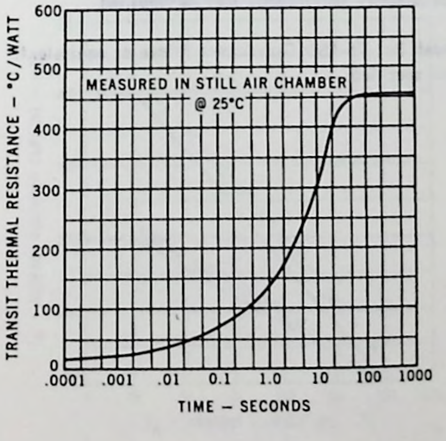
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



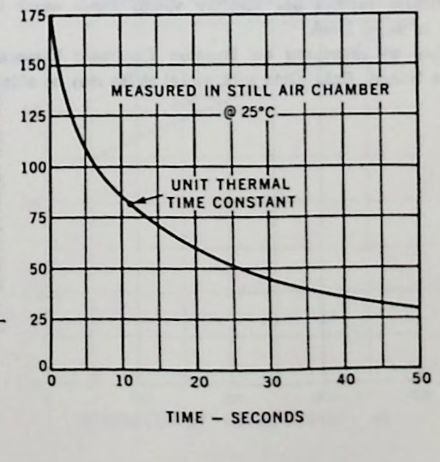
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



TRANSIENT THERMAL RESISTANCE VERSUS TIME



JUNCTION TEMPERATURE VERSUS TIME (COOLING CURVE)

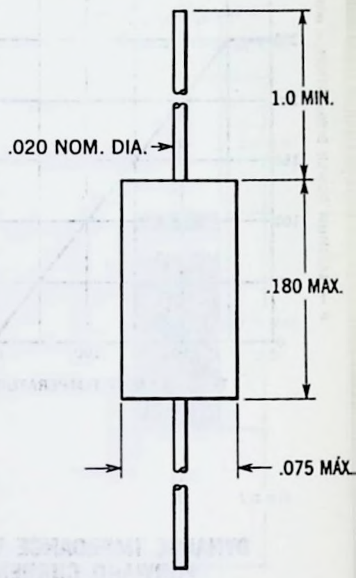


1N4446

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4446 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	70 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_F = 20$ mA
I_{R1}	Reverse Current		25	nA	$V_R = 20$ V
I_{R2}	Reverse Current (+150°C)		50	μA	$V_R = 20$ V
B_V	Breakdown Voltage	100		V	$I_R = 100\ \mu$A
B_V	Breakdown Voltage	75		V	$I_R = 5\ \mu$A
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = 10$ mA, $V_R = 6.0$ V $R_L = 100\ \Omega$
C	Capacitance (Note 3)		4.0	pF	$V_R = 0$ V

*Planar is a patented Fairchild proce

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to $I_R = 1$ mA.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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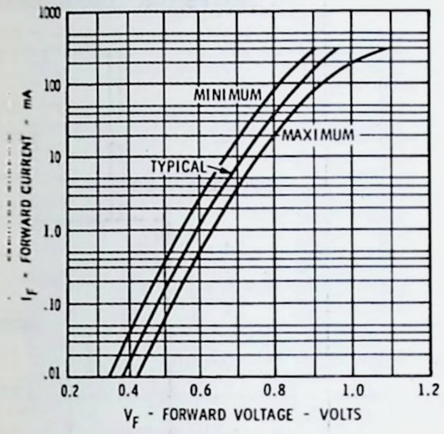
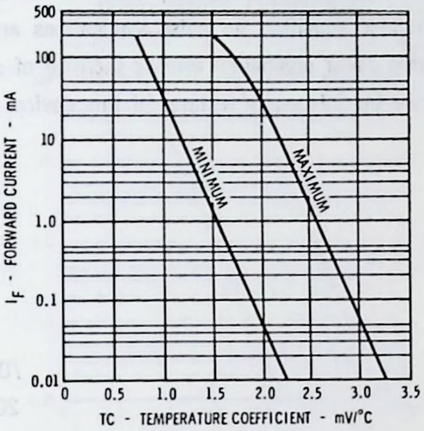
TYPICAL ELECTRICAL CHARACTERISTICS

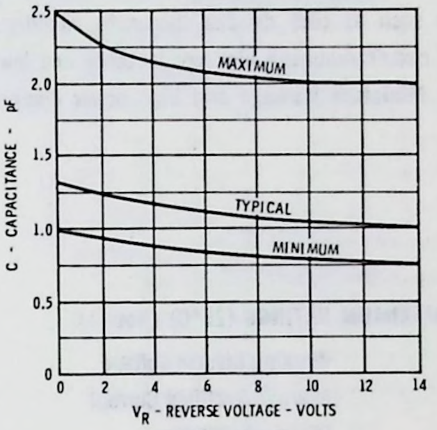
FORWARD VOLTAGE VERSUS FORWARD CURRENT



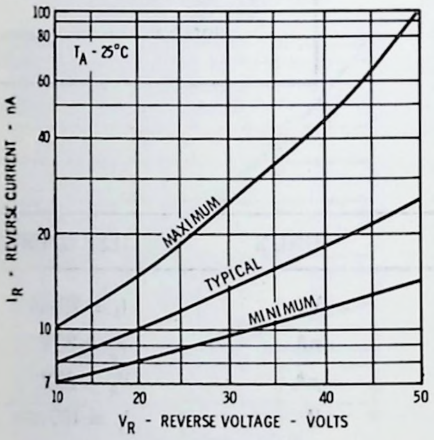
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



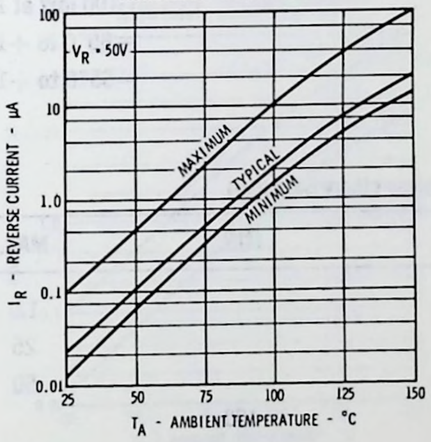
CAPACITANCE VERSUS REVERSE VOLTAGE



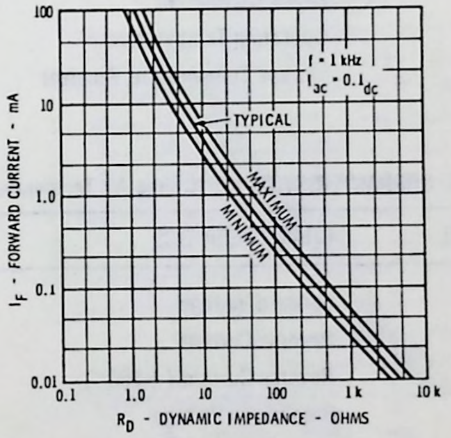
REVERSE CURRENT VERSUS REVERSE VOLTAGE



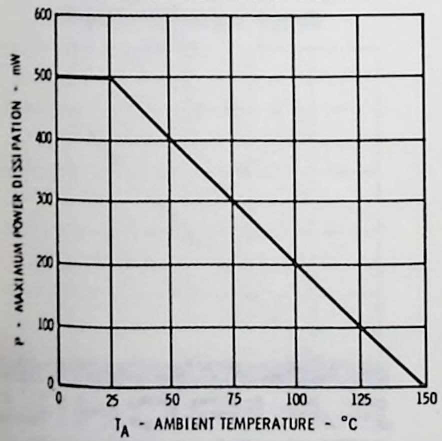
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



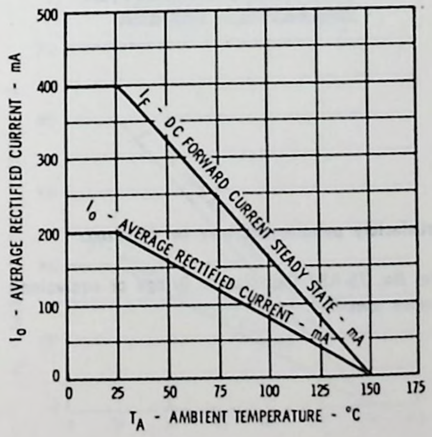
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



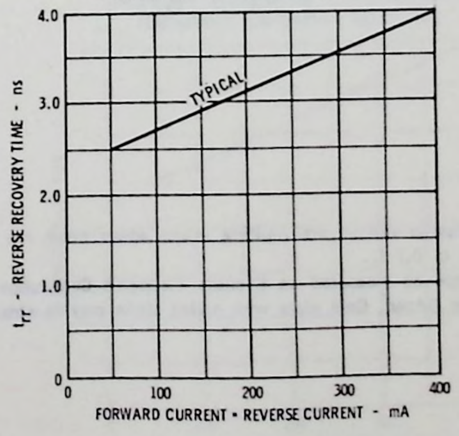
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

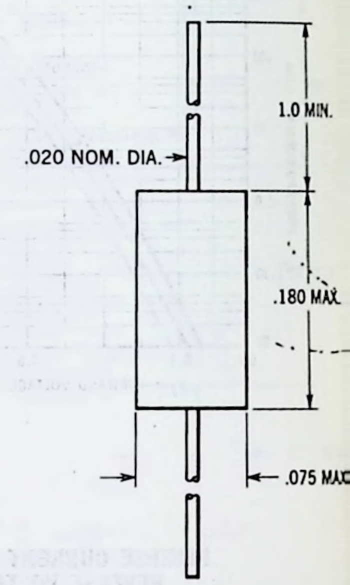


1N4447

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4447 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	70 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_F = 20$ mA
I_{R1}	Reverse Current		25	nA	$V_R = 20$ V
I_{R2}	Reverse Current (+150°C)		50	μA	$V_R = 20$ V
BV	Breakdown Voltage	100		V	$I_R = 100\ \mu$A
T_{RR}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$ mA $R_L = 100\ \Omega$
C	Capacitance (Note 3)		2.0	pF	$V_R = 0$ V

Notes on page 2.

*Planar is a patented Fairchild proc

s:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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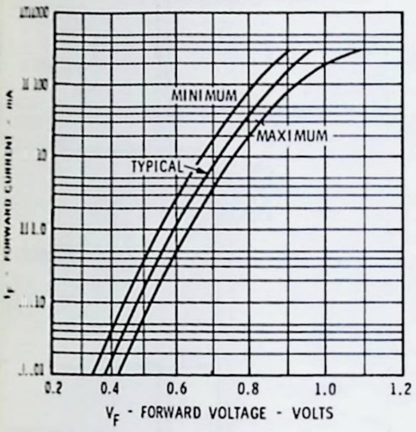
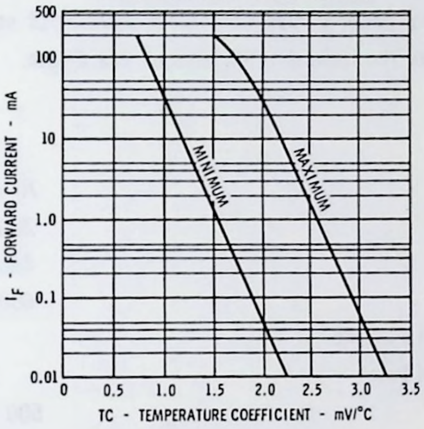
TYPICAL ELECTRICAL CHARACTERISTICS

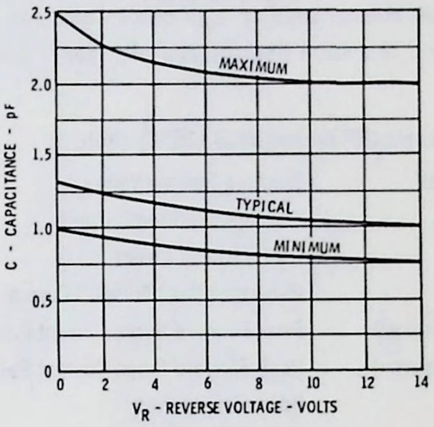
FORWARD VOLTAGE VERSUS FORWARD CURRENT



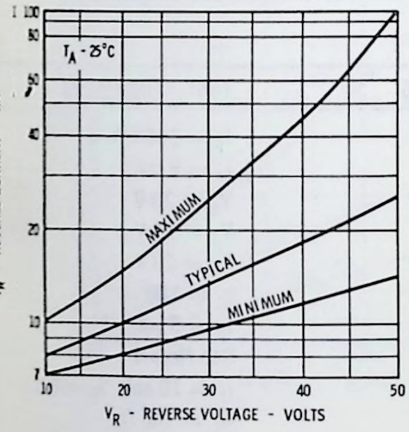
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



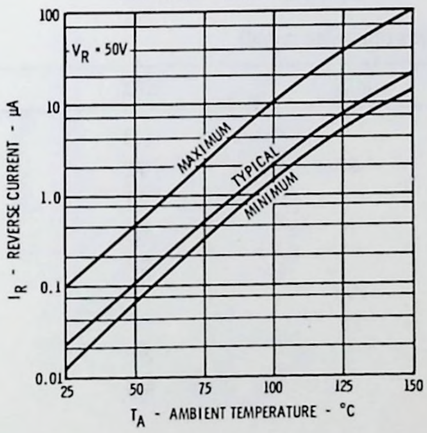
CAPACITANCE VERSUS REVERSE VOLTAGE



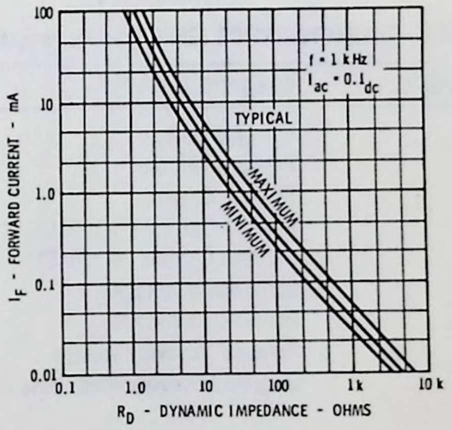
REVERSE CURRENT VERSUS REVERSE VOLTAGE



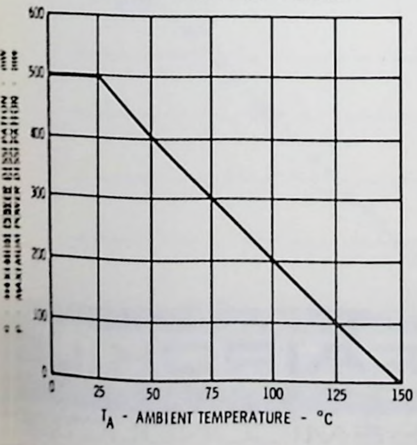
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



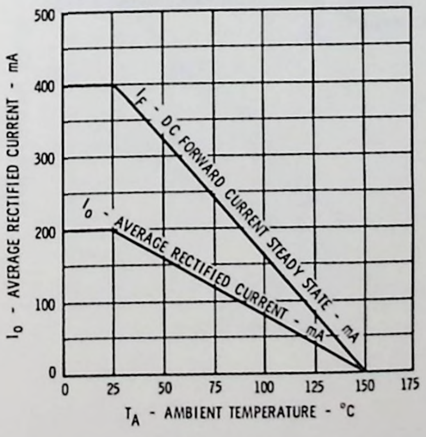
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



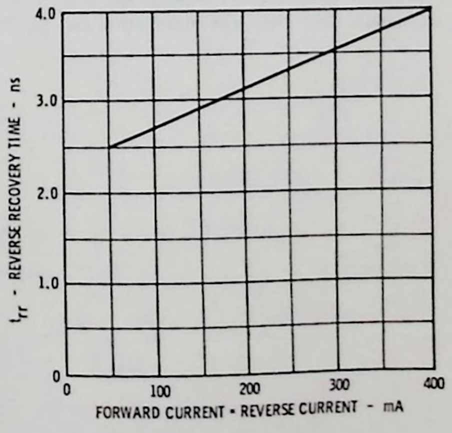
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



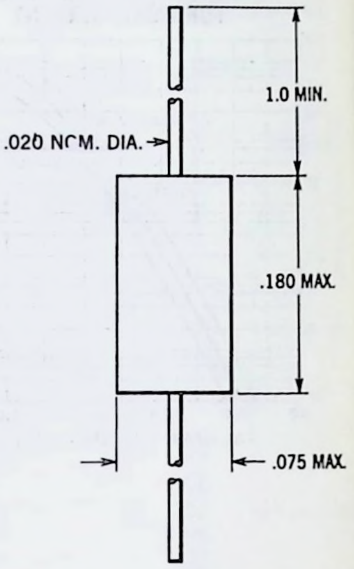
REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)



1N4448
MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4448 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	70 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage		1.0	V	$I_F = 100$ mA
V_{F2}	Forward Voltage	.62	.72	V	$I_F = 5$ mA
I_{R1}	Reverse Current		25	nA	$V_R = 20$ V
I_{R2}	Reverse Current (+100°C)		3.0	μA	$V_R = 20$ V
I_{R3}	Reverse Current (+150°C)		50	μA	$V_R = 20$ V
B_V	Breakdown Voltage	100		V	$I_R = 100\ \mu$A
B_V	Breakdown Voltage	75		V	$I_R = 5\ \mu$A
V_{fr}	Forward Recovery Voltage		2.5	V	See Note 4
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = 10$ mA, $V_R = 6.0$ V $R_L = 100\ \Omega$
C	Capacitance (Note 3)		4.0	pF	$V_R = 0$ V

*Planar is a patented Fairchild proces

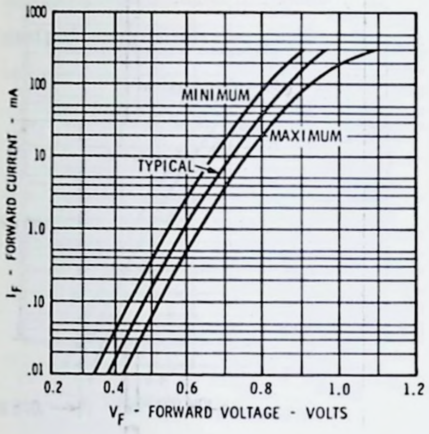
NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to $I_R = 1$ mA.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) $I_F = 50$ mA peak square wave, $t_R < 30$ ns, pulse width = 100 ns, repetition rate = 5-100 KHz.
(5) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

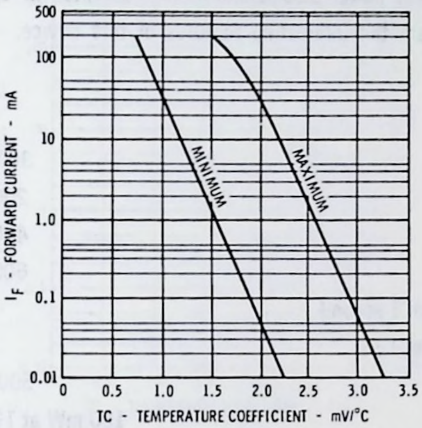
FAIRCHILD DIODE 1N4448

TYPICAL ELECTRICAL CHARACTERISTICS

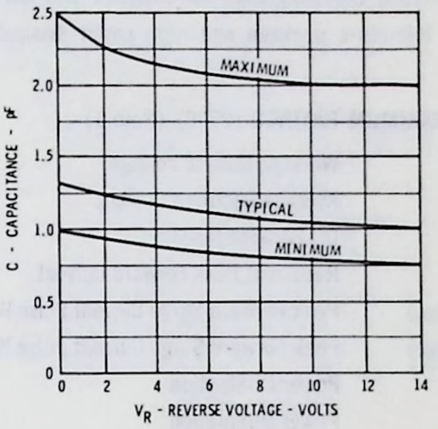
FORWARD VOLTAGE VERSUS FORWARD CURRENT



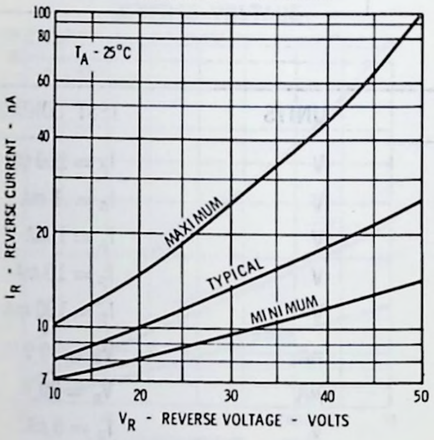
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



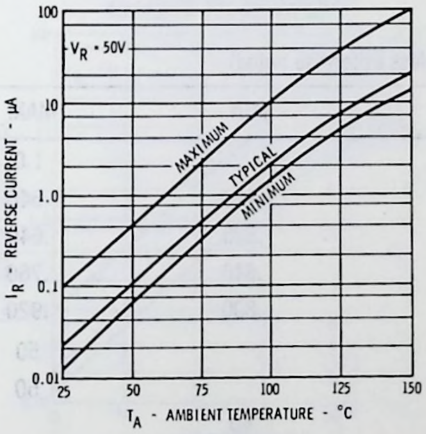
CAPACITANCE VERSUS REVERSE VOLTAGE



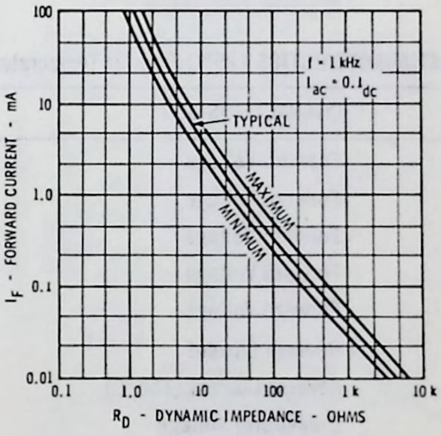
REVERSE CURRENT VERSUS REVERSE VOLTAGE



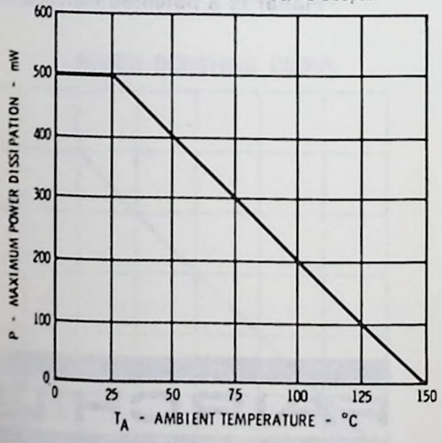
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



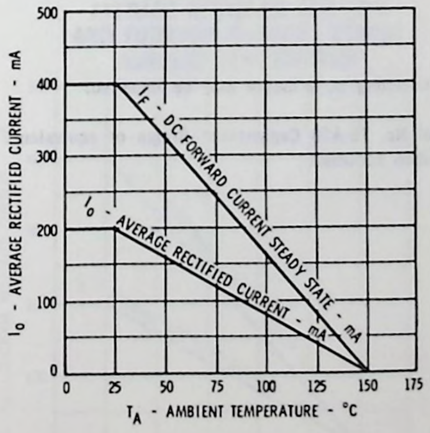
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



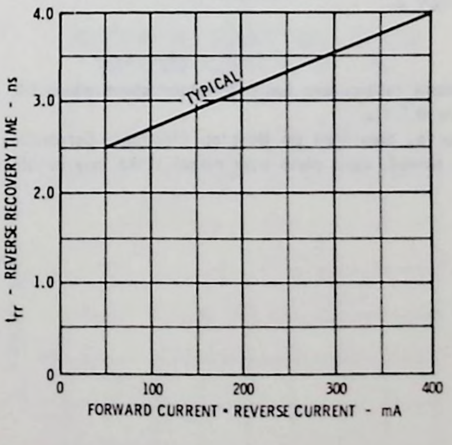
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

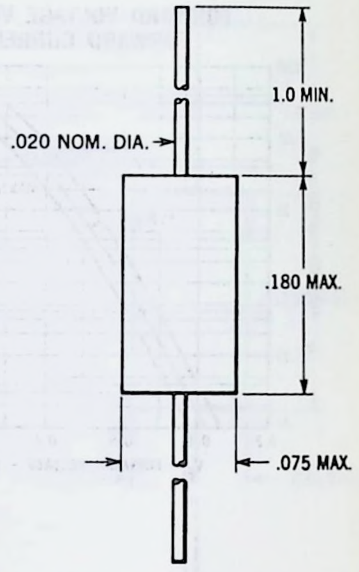


1N4450

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4450 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	30 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage		1.0	V	$I_F = 200$ mA
V_{F2}	Forward Voltage	.420	.540	V	$I_F = .1$ mA
V_{F3}	Forward Voltage	.520	.640	V	$I_F = 1$ mA
V_{F4}	Forward Voltage	.640	.760	V	$I_F = 10$ mA
V_{F5}	Forward Voltage	.800	.920	V	$I_F = 100$ mA
I_{R1}	Reverse Current		50	nA	$V_R = 30$ V
I_{R2}	Reverse Current (150°C)		50	μA	$V_R = 30$ V
BV	Breakdown Voltage	40		V	$I_R = 5\ \mu$A
T_{RR}	Reverse Recovery Time (Note 2)		4.0	nS	$I_F = I_R = 10$ mA $R_L = 100\ \Omega$
C	Capacitance (Note 3)		4.0	pF	$V_R = 0$ V

Notes on page 2.

*Planar is a patented Fairchild process

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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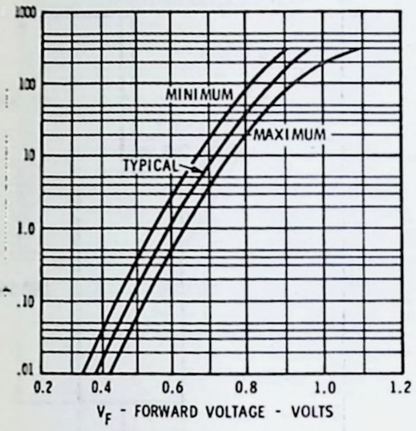
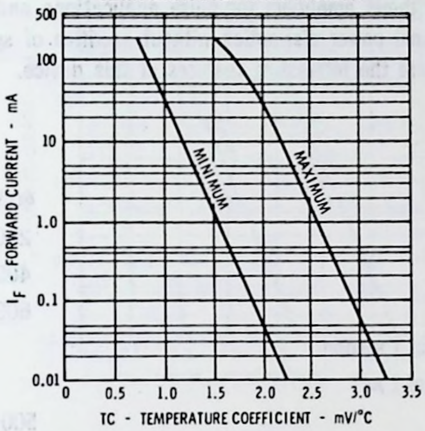
FAIRCHILD DIODE 1N4450

TYPICAL ELECTRICAL CHARACTERISTICS

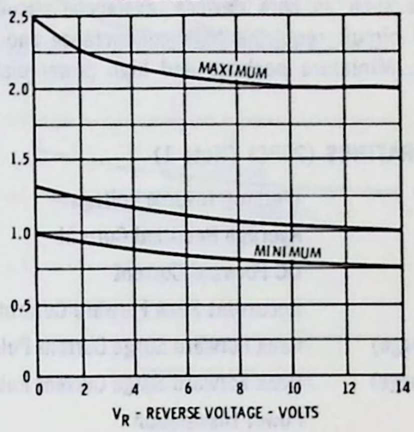
FORWARD VOLTAGE VERSUS FORWARD CURRENT



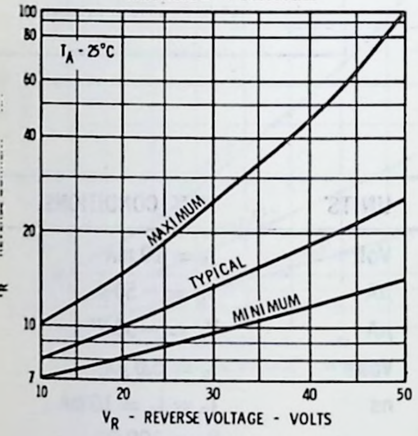
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



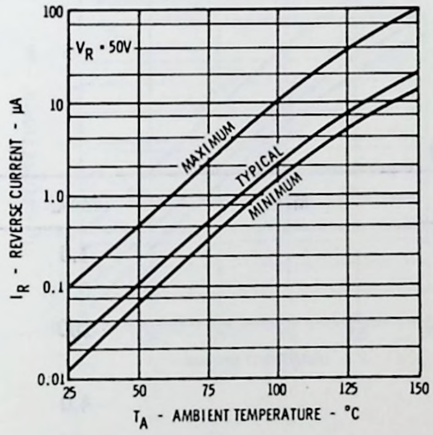
CAPACITANCE VERSUS REVERSE VOLTAGE



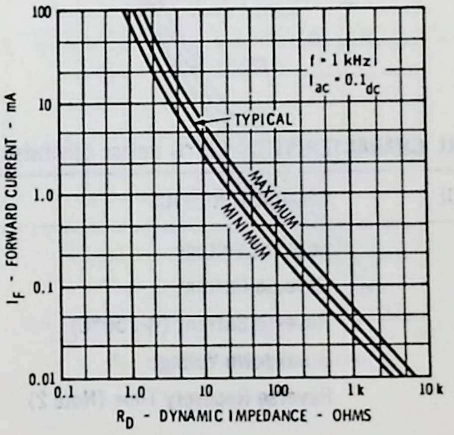
REVERSE CURRENT VERSUS REVERSE VOLTAGE



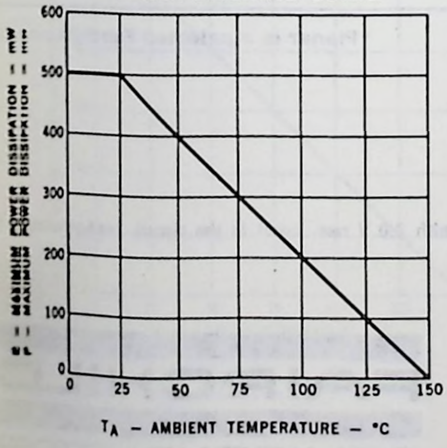
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



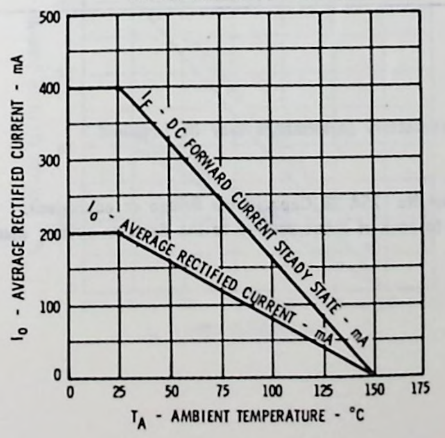
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



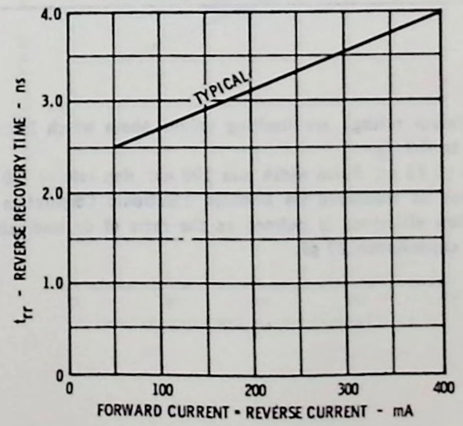
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

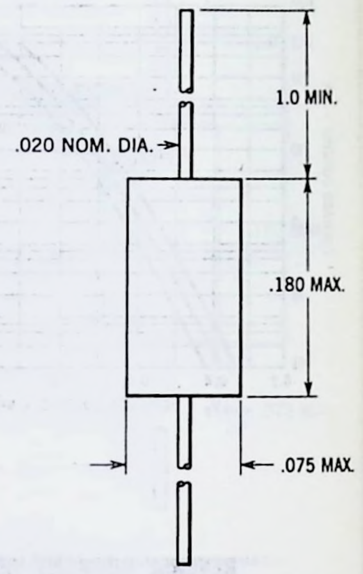


1N4454

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4454 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	Volt	$I_F = 10$ mA
I_R	Reverse Current		0.1	μA	$V_R = -50$ V
I_R	Reverse Current (+150°C)		100	μA	$V_R = -50$ V
BV	Breakdown Voltage	75		Volts	$I_R = 5.0$ μA
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$ mA $R_L = 100\ \Omega$
V_{fr}	Forward Recovery Peak Voltage (Note 3)		3.0	Volts	$I_f = 100$ mA pulse
C	Capacitance (Note 4)		2.0	pF	$V_R = 0$ V, f = 1.0 MHz
RE	Rectification Efficiency (Note 5)	45		%	f = 100 MHz
ΔV_f/°C	Forward Voltage Temperature Coefficient		3.0	mV/°C	

*Planar is a patented Fairchild process

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Rise time ≤ 20 ns; Pulse width min 100 ns; Rep rate = 100 KHz.
(4) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
(5) Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms. input to the circuit. Load resistance 5 kΩ, load capacitance 20 pF.

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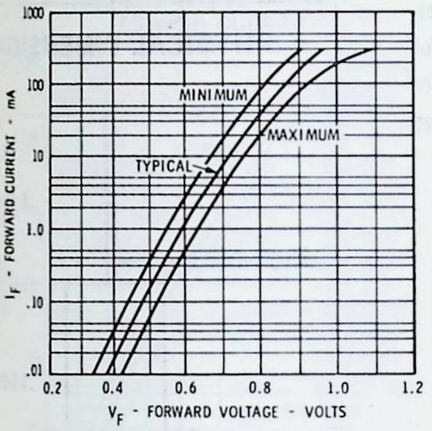
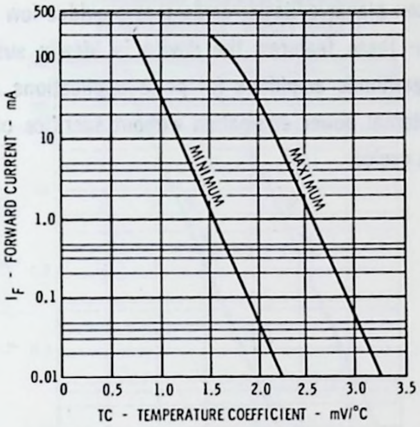
FAIRCHILD DIODE 1N4454

TYPICAL ELECTRICAL CHARACTERISTICS

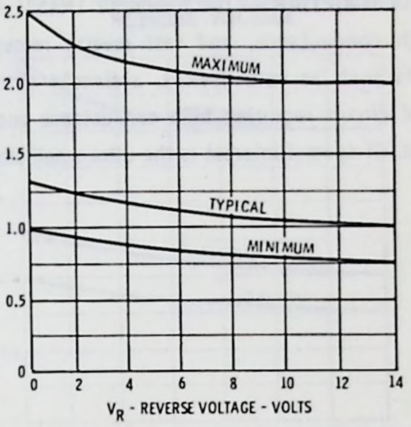
FORWARD VOLTAGE VERSUS FORWARD CURRENT



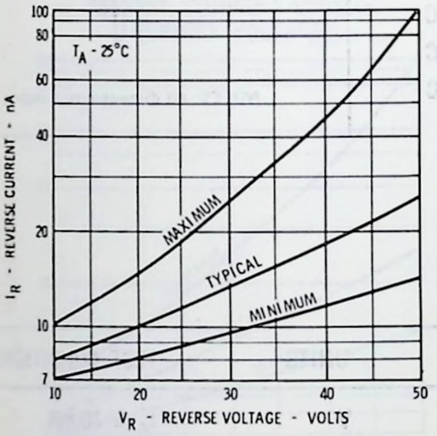
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



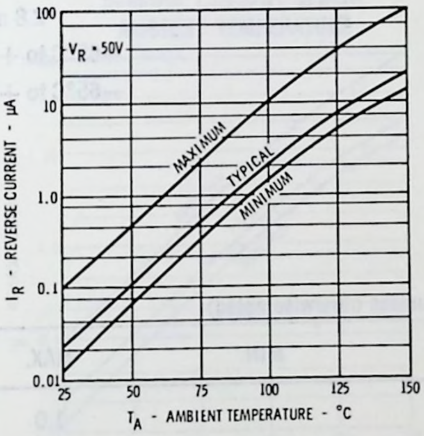
CAPACITANCE VERSUS REVERSE VOLTAGE



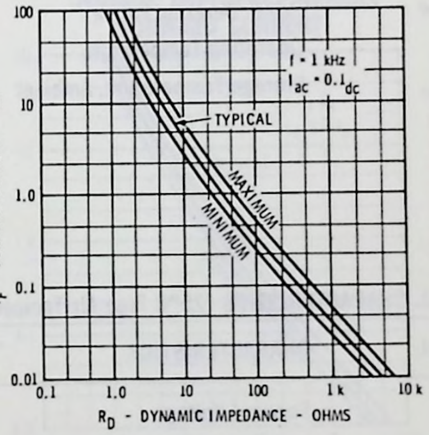
REVERSE CURRENT VERSUS REVERSE VOLTAGE



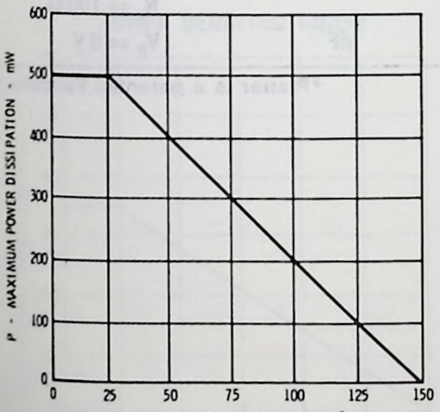
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



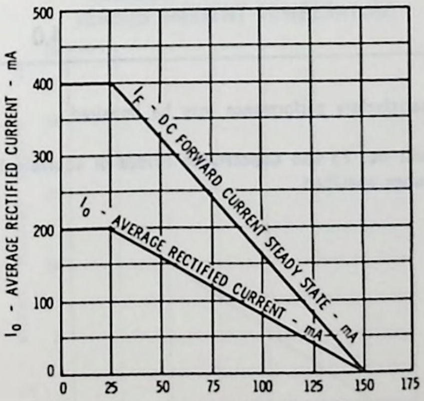
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



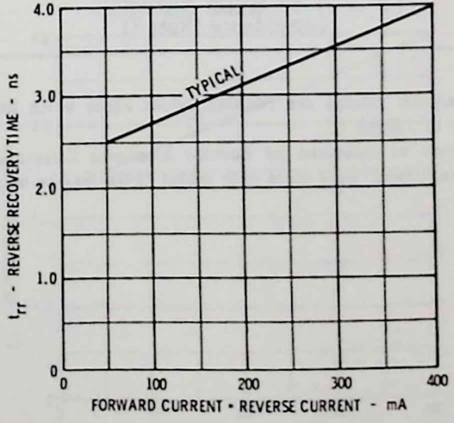
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

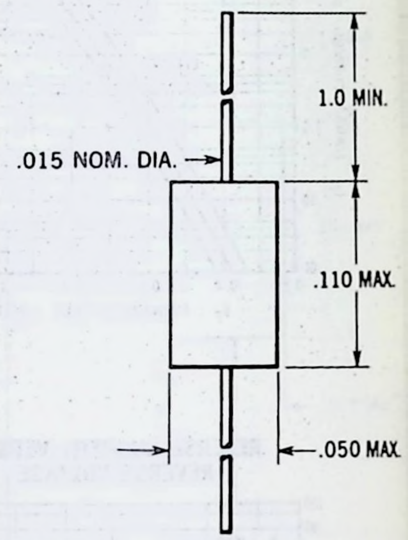


1N4531

ULTRA COMPACT, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4531 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Of special interest is the ultra-small size of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	75 Volts
P	Power Dissipation (Package)	350 mW
$1/\theta$	Power Derating Factor	2.8 mW/°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +200°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	V	$I_F = 10$ mA
I_{R1}	Reverse Current		25	nA	$V_R = 20$ V
I_{R2}	Reverse Current (+150°C)		50	μA	$V_R = 20$ V
BV	Breakdown Voltage	100		V	$I_R = 100$ μA
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = 10$ mA; $V_R = 6$ V $R_L = 100\ \Omega$
C	Capacitance (Note 3)		4.0	pF	$V_R = 0$ V

*Planar is a patented Fairchild Proces

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 1.0 mA I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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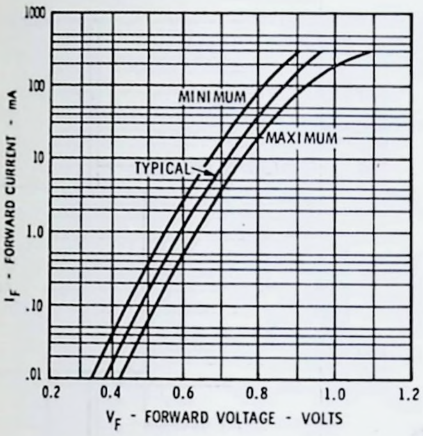
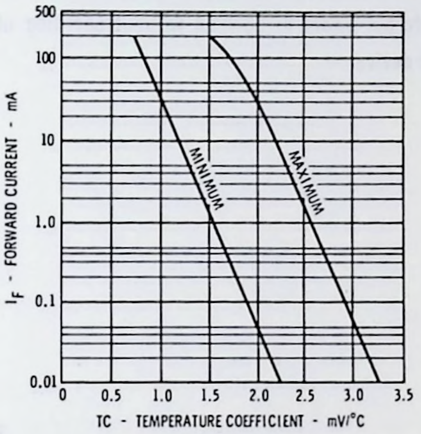
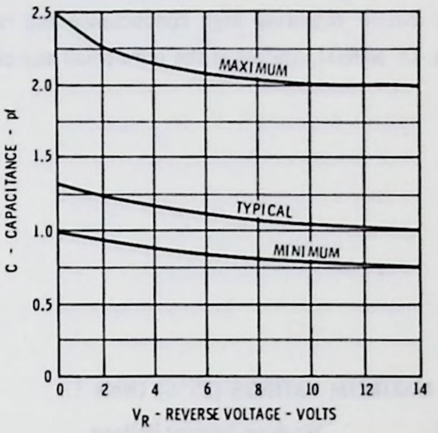
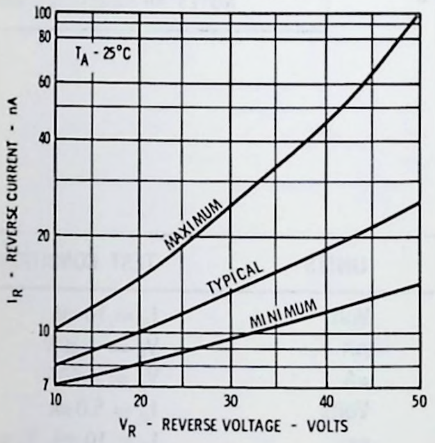
FAIRCHILD DIODE 1N4531

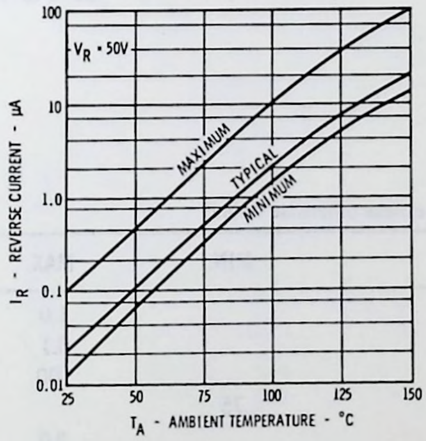
TYPICAL ELECTRICAL CHARACTERISTICS

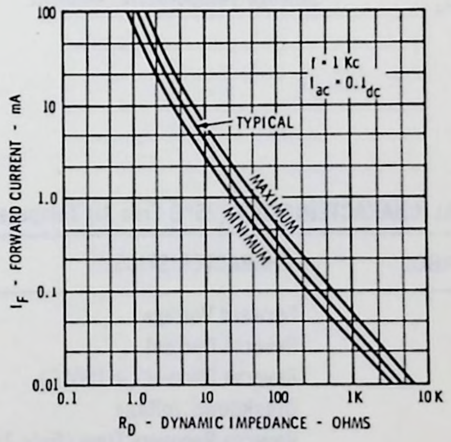

FORWARD VOLTAGE VERSUS FORWARD CURRENT

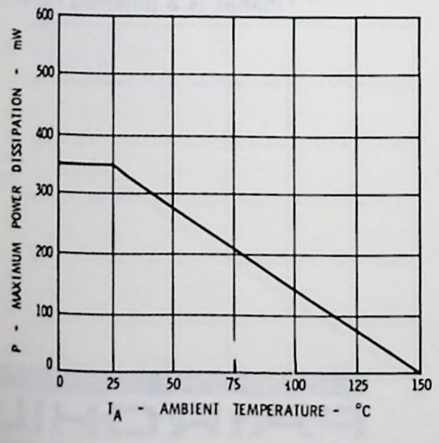

FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT

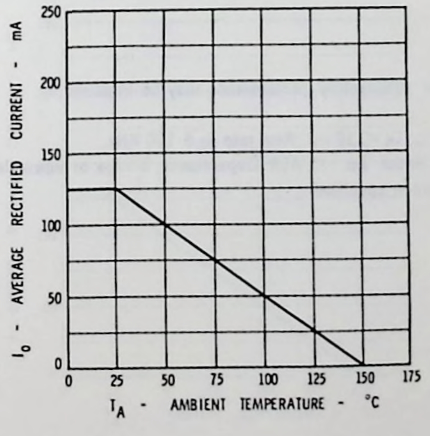

CAPACITANCE VERSUS REVERSE VOLTAGE

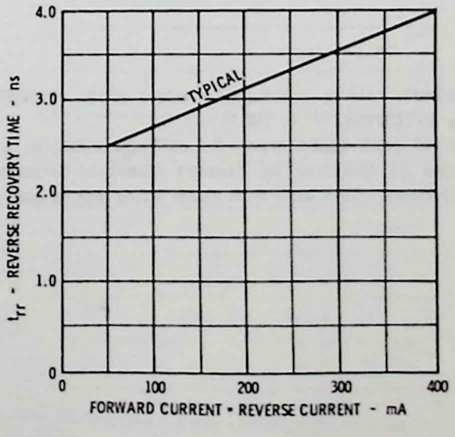

REVERSE CURRENT VERSUS REVERSE VOLTAGE


REVERSE CURRENT VERSUS AMBIENT TEMPERATURE


DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT


POWER DERATING CURVE


AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE

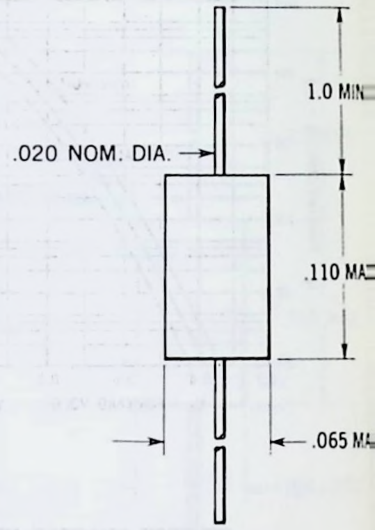

REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

1N4532

ULTRA COMPACT, HIGH CONDUCTANCE
ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4532 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Of special interest is the ultra-small size of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	75 Volts
P	Power Dissipation (Package)	350 mW
$1/\theta$	Power Derating Factor	2.8 mW/°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +200°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.0	Volt	$I_F = 10$ mA
I_R	Reverse Current		0.1	μA	$V_R = -50$ V
I_R	Reverse Current (+150°C)		100	μA	$V_R = -50$ V
B_V	Breakdown Voltage	75		Volts	$I_R = 5.0$ μA
t_{rr}	Reverse Recovery Time (Note 2)		2.0	ns	$I_F = 10$ mA, $V_R = 6.0$ V
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$ mA
V_{fr}	Forward Recovery Peak Voltage (Note 3)		3.0	Volts	$I_f = 100$ mA pulse
C	Capacitance (Note 4)		2.0	pF	$V_R = 0$ V, f = 1.0 MHz

*Planar is a patented Fairchild pro

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 1.0 mA. $R_L = 100\ \Omega$.
(3) $I_F = 100$ mA peak square wave; 0.1 μs Pulse width; $R_L = 50\ \Omega$; $T_R \leq 30$ ns; Rep rate = 5-100 KHz.
(4) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(5) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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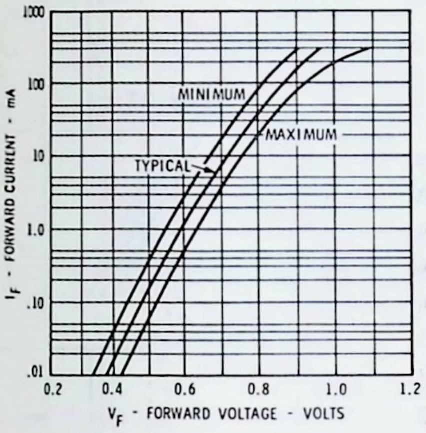
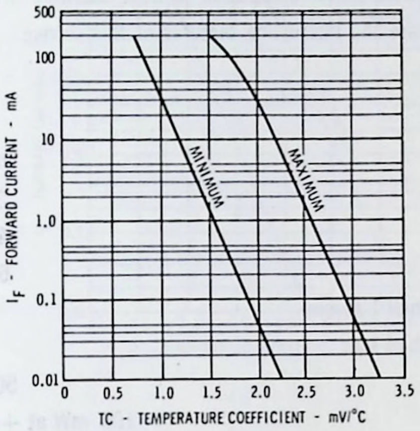
FAIRCHILD DIODE 1N4532

TYPICAL ELECTRICAL CHARACTERISTICS

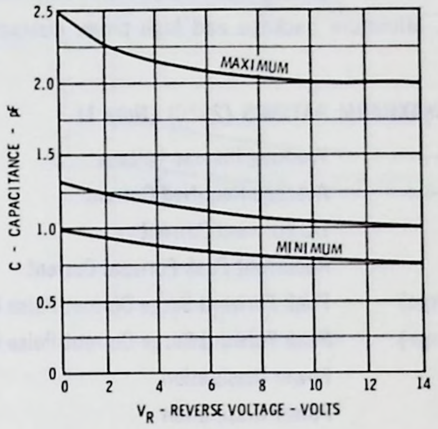
FORWARD VOLTAGE VERSUS FORWARD CURRENT



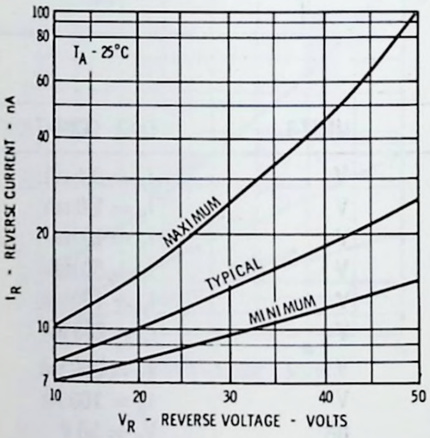
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



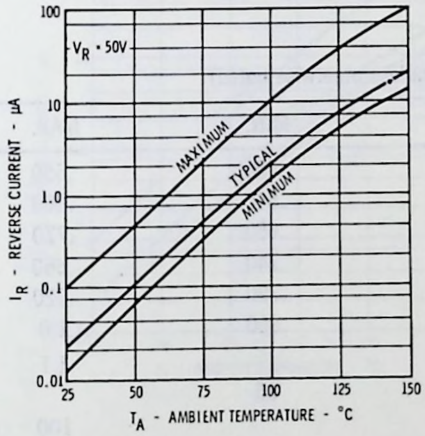
CAPACITANCE VERSUS REVERSE VOLTAGE



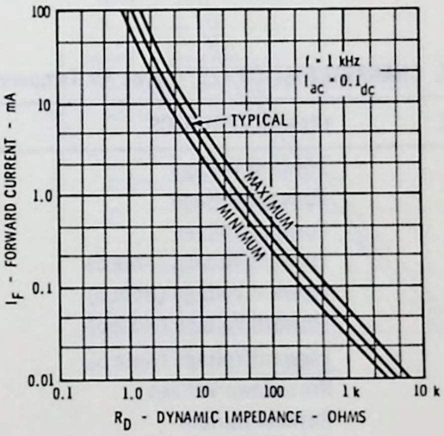
REVERSE CURRENT VERSUS REVERSE VOLTAGE



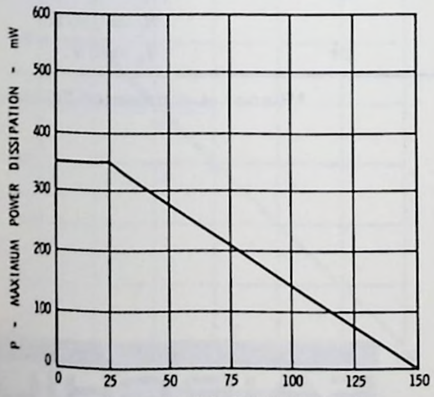
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



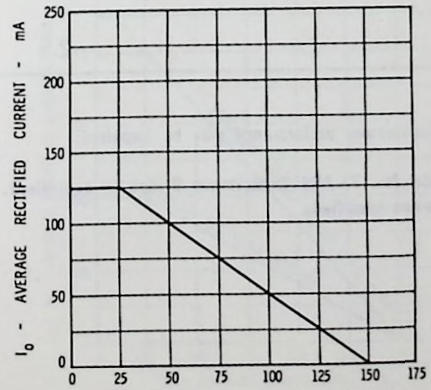
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



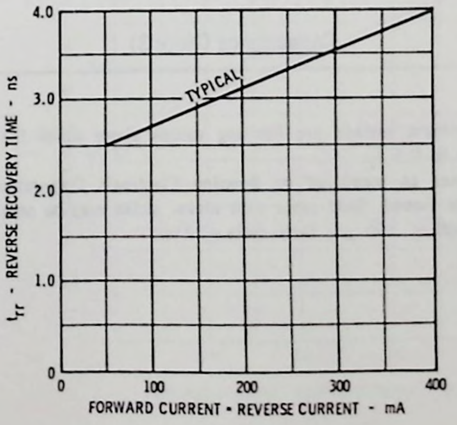
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

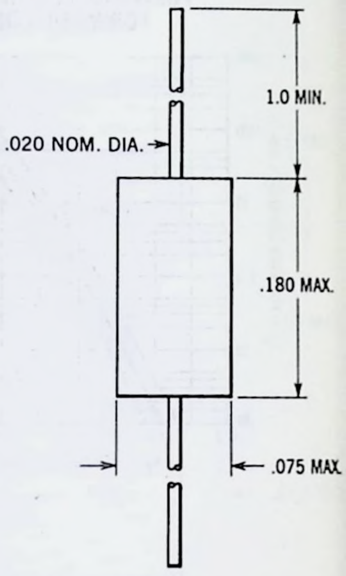


1N4606

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4606 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	70 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at +125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage	.430	.550	V	$I_F = 0.1$ mA
V_F	Forward Voltage	.540	.660	V	$I_F = 1.0$ mA
V_F	Forward Voltage	.650	.770	V	$I_F = 10$ mA
V_F	Forward Voltage (Note 5)	.740	.860	V	$I_F = 50$ mA
V_F	Forward Voltage (Note 5)	.790	.920	V	$I_F = 100$ mA
V_F	Forward Voltage (Note 5)	.860	1.0	V	$I_F = 200$ mA
V_F	Forward Voltage (Note 5)		1.1	V	$I_F = 250$ mA
BV	Breakdown Voltage	85		V	$I_R = 100\ \mu$A
I_{R1}	Reverse Current		100	nA	$V_R = 50$ V
I_{R2}	Reverse Current		250	nA	$V_R = 70$ V
I_{R3}	Reverse Current (+100°C)		25	μA	$V_R = 50$ V
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$-200 mA $R_L = 100\ \Omega$
t_{rr}	Reverse Recovery Time (Note 2)		6	ns	$I_F = I_R = 200$-400 mA $R_L = 100\ \Omega$
C	Capacitance (Note 3)		2.5	pF	$V_R = 0$ V

*Planar is a patented Fairchild Proce

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.
(5) Pulse width ≤ 300 μs; Duty cycle ≤ 2%.

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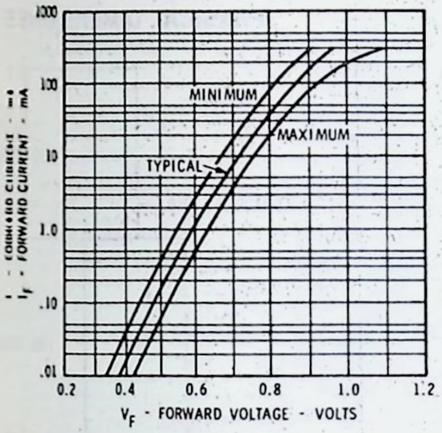
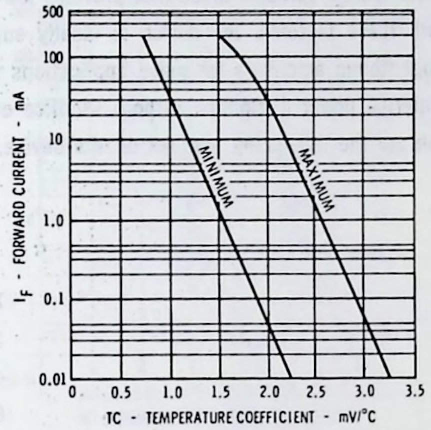
TYPICAL ELECTRICAL CHARACTERISTICS

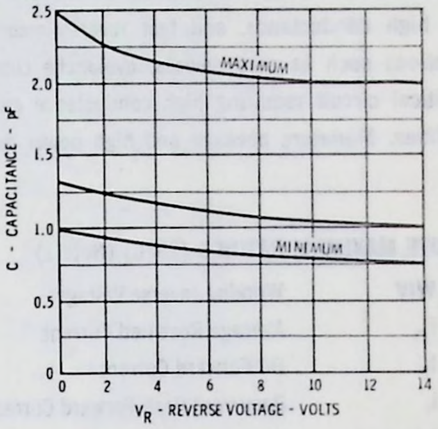
FORWARD VOLTAGE VERSUS FORWARD CURRENT



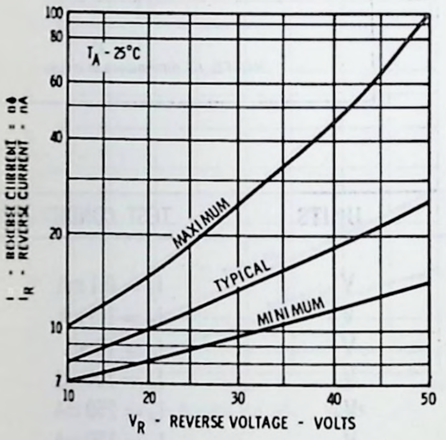
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



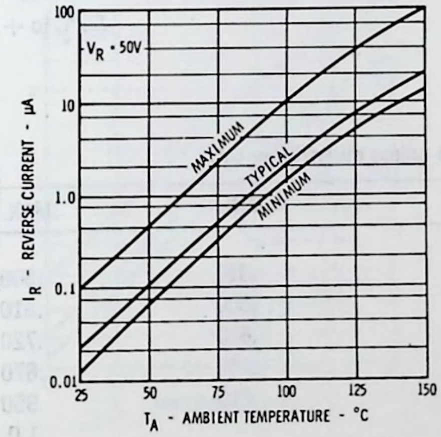
CAPACITANCE VERSUS REVERSE VOLTAGE



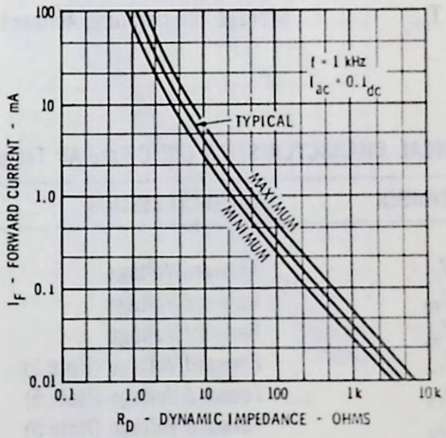
REVERSE CURRENT VERSUS REVERSE VOLTAGE



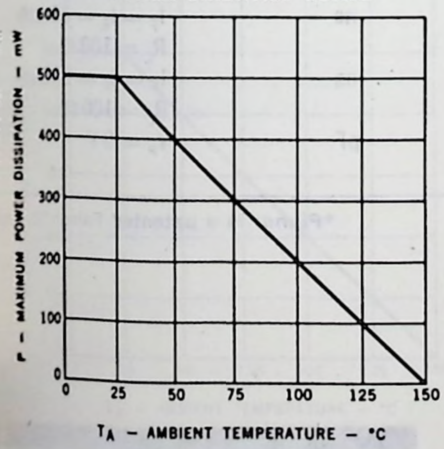
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



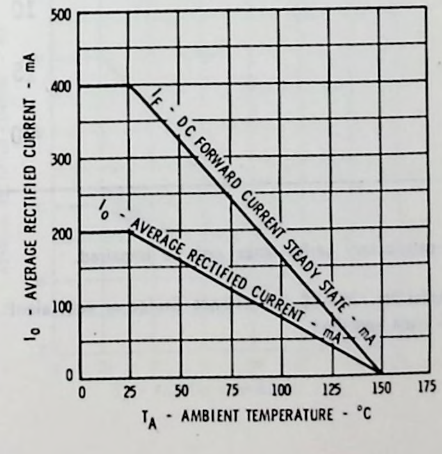
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



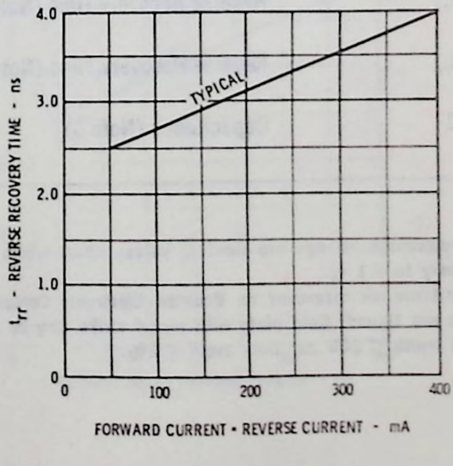
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

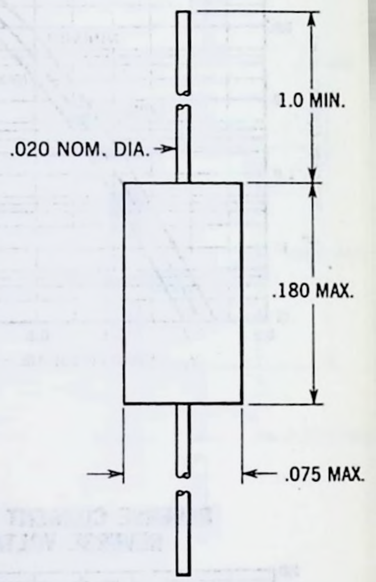


1N4607

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4607 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	70 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at +125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage	.390	.500	V	$I_F = 0.1$ mA
V_{F2}	Forward Voltage	.500	.610	V	$I_F = 1.0$ mA
V_{F3}	Forward Voltage	.610	.720	V	$I_F = 10$ mA
V_{F4}	Forward Voltage (Note 5)	.740	.870	V	$I_F = 100$ mA
V_{F5}	Forward Voltage (Note 5)	.810	.950	V	$I_F = 250$ mA
V_{F6}	Forward Voltage (Note 5)		1.0	V	$I_F = 350$ mA
V_{F7}	Forward Voltage (Note 5)		1.1	V	$I_F = 400$ mA
I_{R1}	Reverse Current		250	nA	$V_R = 70$ V
I_{R3}	Reverse Current (+100°C)		25	μA	$V_R = 50$ V
I_{R2}	Reverse Current		100	nA	$V_R = 50$ V
BV	Breakdown Voltage	85		V	$I_R = 100$ μA
t_{rr}	Reverse Recovery Time (Note 2)		10	ns	$I_F = I_R = 10$ mA $R_L = 100\ \Omega$
t_{rr}	Reverse Recovery Time (Note 2)		15	ns	$I_F = I_R = 500$ mA $R_L = 100\ \Omega$
C	Capacitance (Note 3)		4.0	pF	$V_R = 0$ V

*Planar is a patented Fairchild Proce

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.
(5) Pulse width ≤ 300 μs; Duty cycle ≤ 2%.

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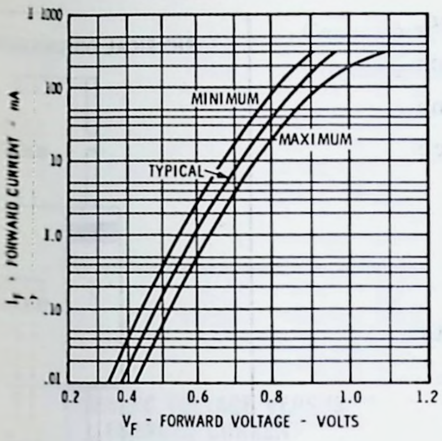
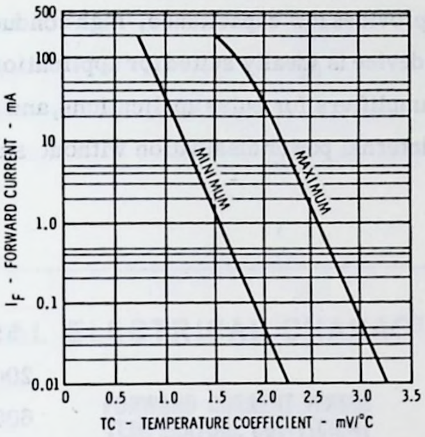
FAIRCHILD DIODE 1N4607

TYPICAL ELECTRICAL CHARACTERISTICS

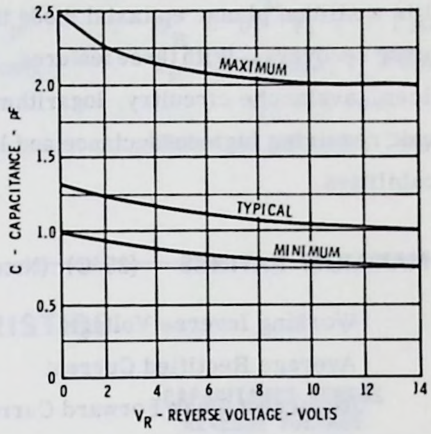
FORWARD VOLTAGE VERSUS FORWARD CURRENT



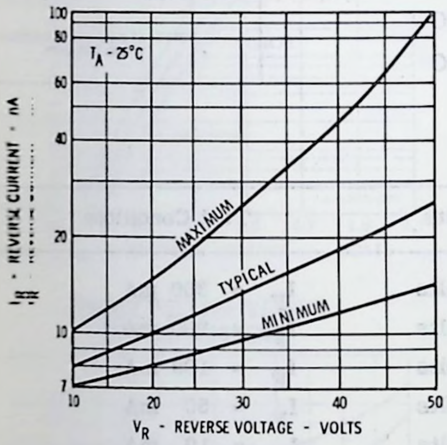
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



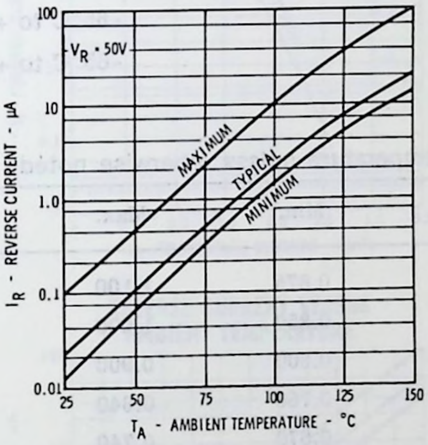
CAPACITANCE VERSUS REVERSE VOLTAGE



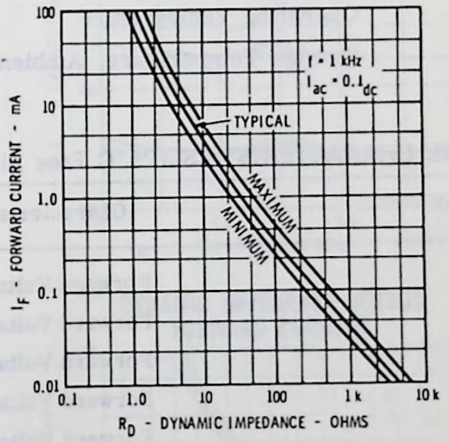
REVERSE CURRENT VERSUS REVERSE VOLTAGE



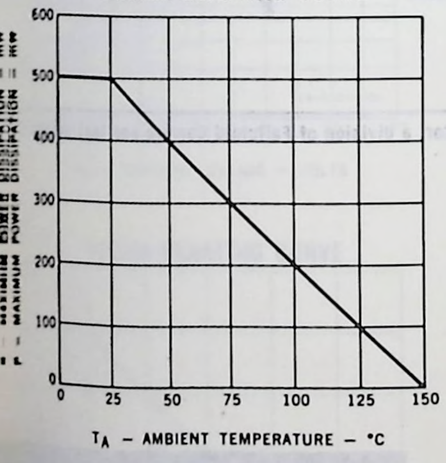
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



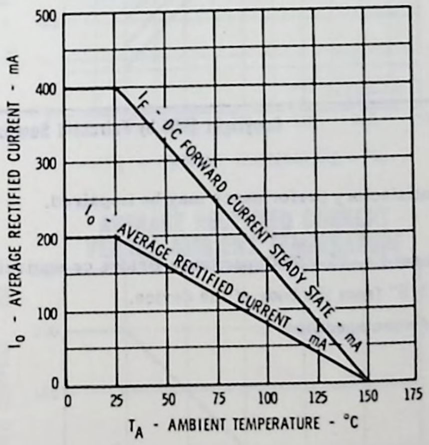
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



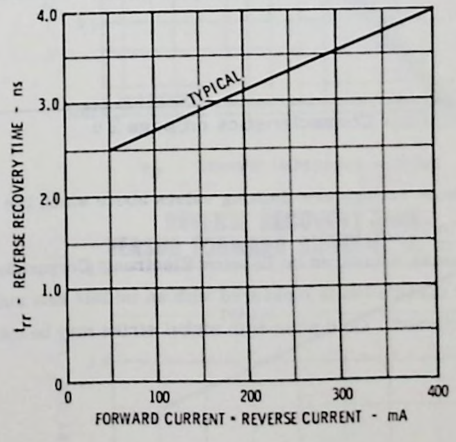
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

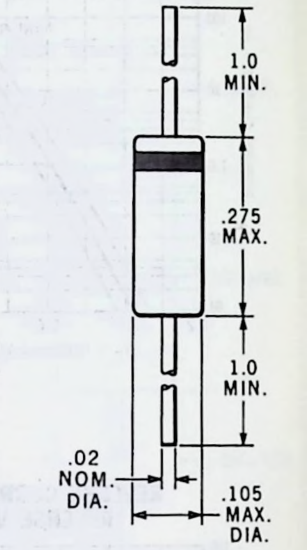


1N4610

HIGH CONDUCTANCE ULTRA FAST EPITAXIAL PLANAR DIODE

The 1N4610 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications, and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Weight: 0.25 gram.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	55 Volts
I_o	Average Rectified Current	200 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f (surge)	Peak Forward Surge Current Pulse Width of 1 second	1.0 Amp
i_f (surge)	Peak Forward Surge Current Pulse Width of 1 μsec	4.0 Amp
P	Power Dissipation	500 mW
P	Power Dissipation	170 mW at 125°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{F1}	Forward Voltage	0.875	1.100	Volts	I_F = 300 mA
V_{F2}	Forward Voltage	0.850	1.000	Volts	I_F = 200 mA
V_{F3}	Forward Voltage	0.800	0.900	Volts	I_F = 100 mA
V_{F4}	Forward Voltage	0.760	0.840	Volts	I_F = 50 mA
V_{F5}	Forward Voltage	0.670	0.740	Volts	I_F = 10 mA
V_{F6}	Forward Voltage	0.640	0.705	Volts	I_F = 5 mA
V_{F7}	Forward Voltage	0.560	0.620	Volts	I_F = 1 mA
V_{F8}	Forward Voltage	0.530	0.590	Volts	I_F = 0.5 mA
V_{F9}	Forward Voltage	0.455	0.505	Volts	I_F = 0.1 mA

Additional Electrical Characteristics on page 2

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NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 10% of I_F.

(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

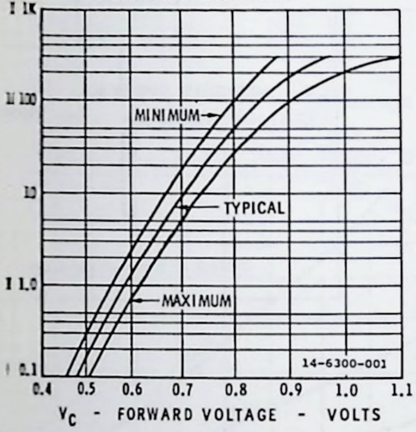
(4) The power dissipation is measured with an infinite heat sink at 3/8" from the body of the device.

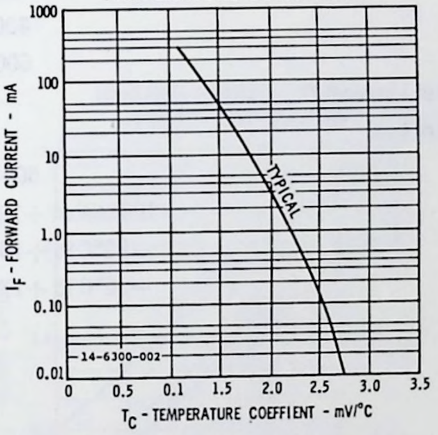
(5) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

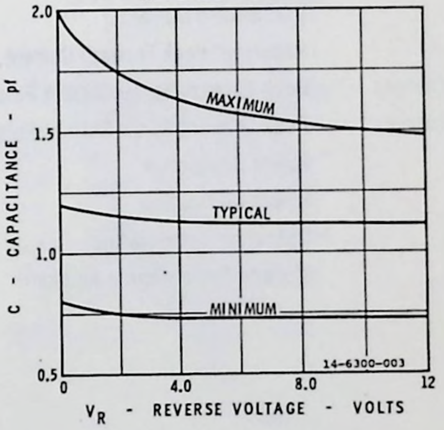
ICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

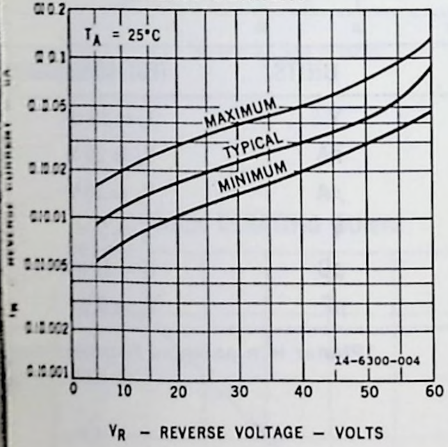
	Characteristic	Min.	Max.	Units	Test Conditions
	Reverse Current	-	100	nA	V_R = -55 V
(150°C)	Reverse Current	-	100	µA	V_R = -55 V
	Breakdown Voltage	80		Volts	I_R = 5 µA
(Note 2)	Reverse Recovery	-	4.0	nsec	$I_F = I_R$ = 10 to 200 mA, R_L = 100 Ω
(Note 2)	Reverse Recovery	-	2.0	nsec	I_F = 10 mA, V_R = 6 V, R_L = 100 Ω
	Capacitance		2.0	pf	V_R = 0 V, f = 1 Mc
	Forward Recovery	-	10	nsec	I_F = 200 mA, t_r = 0.4 nsec, v_{fr} = 1 volt Pulse = 100 nsec, Duty cycle ≤ 1%

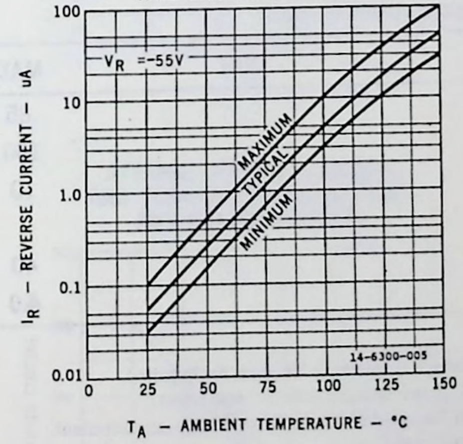
TYPICAL ELECTRICAL CHARACTERISTICS

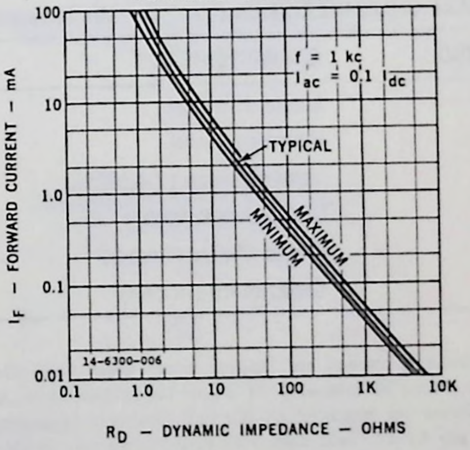

FORWARD VOLTAGE VERSUS FORWARD CURRENT

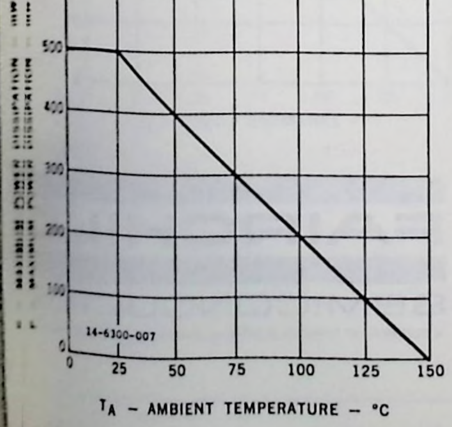

FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT

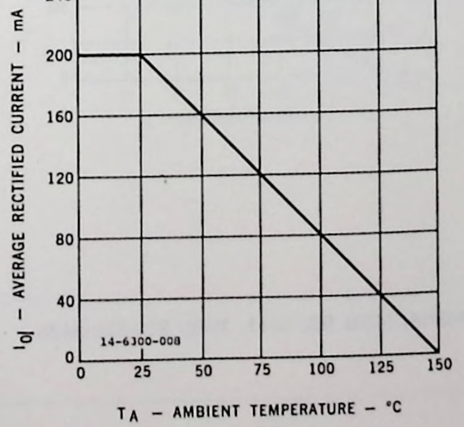

CAPACITANCE VERSUS REVERSE VOLTAGE

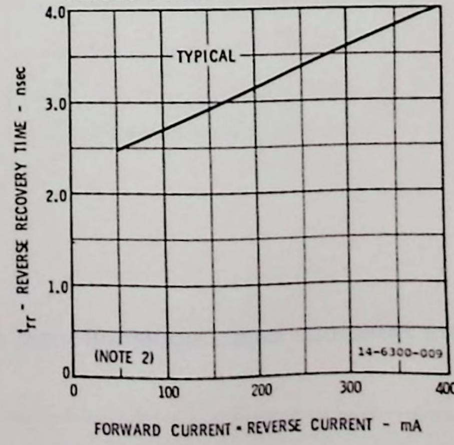

REVERSE VOLTAGE VERSUS REVERSE CURRENT


REVERSE CURRENT VERSUS AMBIENT TEMPERATURE


DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT


POWER DERATING CURVE


AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE

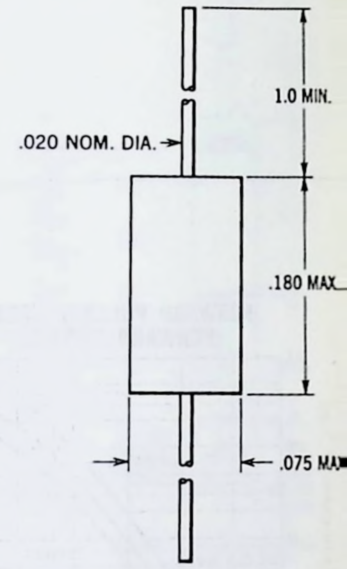

REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

1N4727

MINIATURE SIZE, HIGH CONDUCTANCE ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N4727 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	20 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	100 mW at +125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITION
V_F	Forward Voltage		.85	V	$I_F = 10$ mA
I_{R1}	Reverse Current		100	nA	$V_R = 20$ V
I_{R2}	Reverse Current (+100°C)		10	μA	$V_R = 20$ V
BV	Breakdown Voltage	30		V	$I_R = 5\ \mu$A
Q_S	Stored Charge (Note 2)		40	pC	$I_F = 10$ mA
C	Capacitance (Note 3)		4.0	pF	$V_R = 0$ V

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Stored charge as measured on B-Line Corporation Model No. QS-3 stored charge meter or equivalent.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

*Planar is a patented Fairchild Proc

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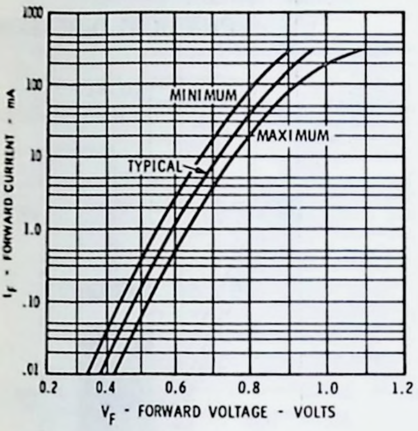
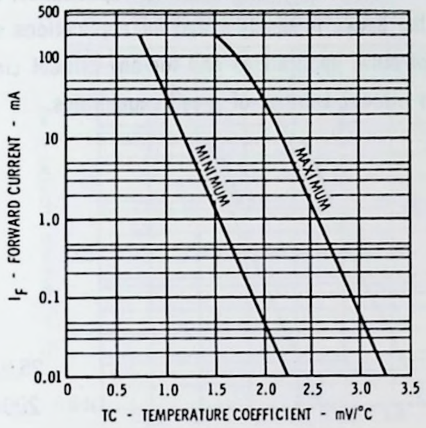
TYPICAL ELECTRICAL CHARACTERISTICS

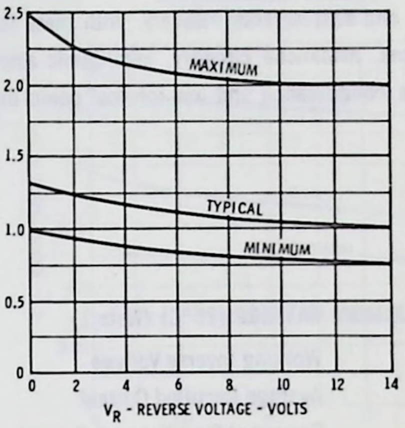
FORWARD VOLTAGE VERSUS FORWARD CURRENT



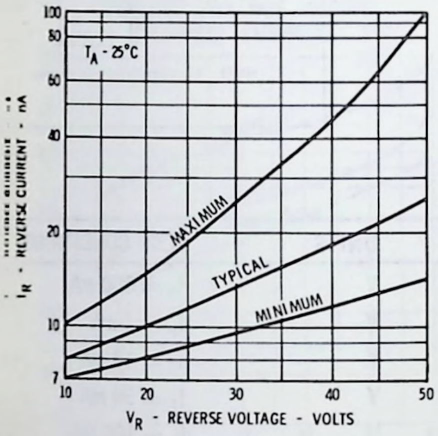
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



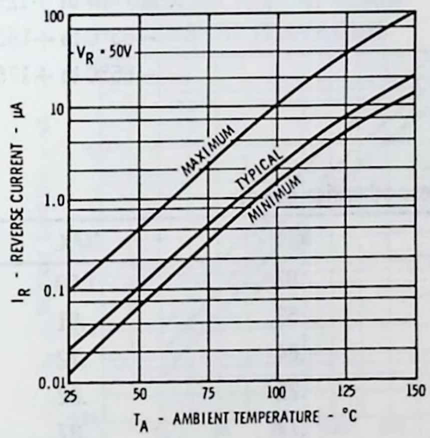
CAPACITANCE VERSUS REVERSE VOLTAGE



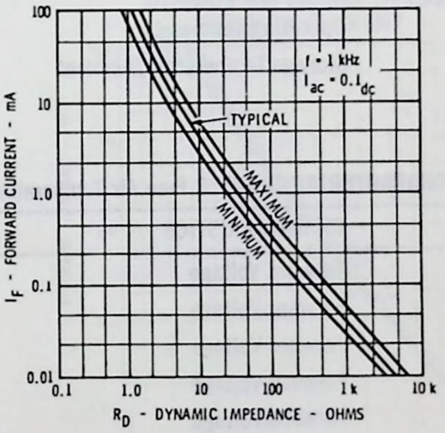
REVERSE CURRENT VERSUS REVERSE VOLTAGE



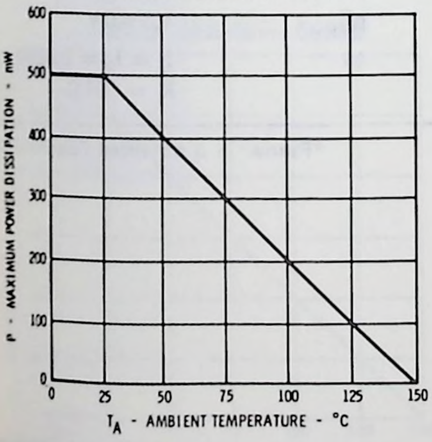
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



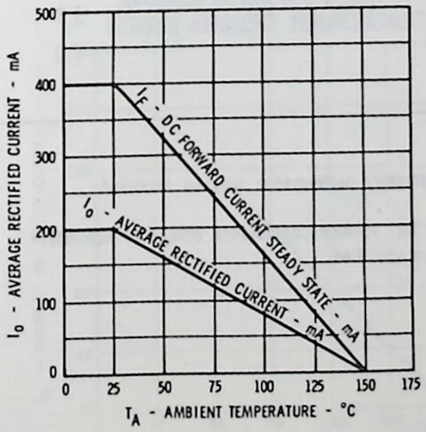
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



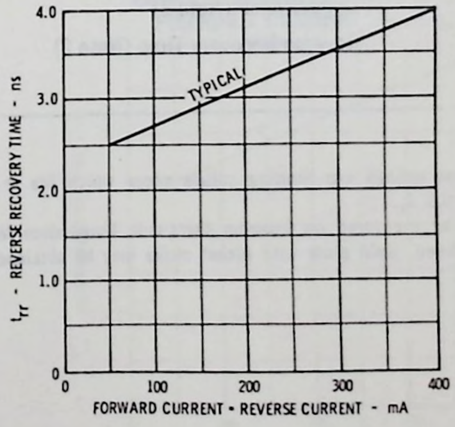
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

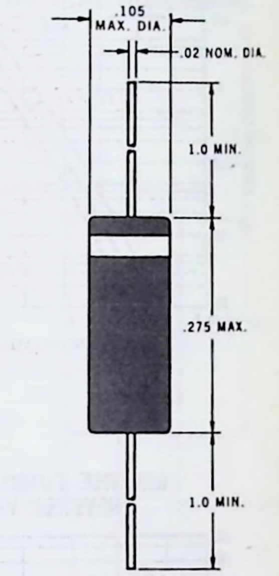


1N4950

HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The 1N4950 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities.

PHYSICAL DIMENSIONS



NOTE: All dimensions in inches

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	25 Volts
I_O	Average Rectified Current	200 mA
i_f	Recurrent Peak Forward Current	900 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation	170 mW at +125°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage	.87	1.00	V	$I_F = 300$ mA
V_{F2}	Forward Voltage	.53	.61	V	$I_F = 1$ mA
V_{F3}	Forward Voltage	.64	.72	V	$I_F = 10$ mA
V_{F4}	Forward Voltage	.72	.82	V	$I_F = 50$ mA
V_{F5}	Forward Voltage	.77	.87	V	$I_F = 100$ mA
V_{F6}	Forward Voltage	.83	.93	V	$I_F = 200$ mA
I_{R1}	Reverse Current		100	nA	$V_R = 25$ V
I_{R2}	Reverse Current (+150°C)		100	μA	$V_R = 25$ V
BV	Breakdown Voltage	30		V	$I_R = 5$ μA
C	Capacitance (Note 3)		3.3	pF	$V_R = 0$ V
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$-200 mA $R_L = 100\ \Omega$

*Planar is a patented Fairchild Proc

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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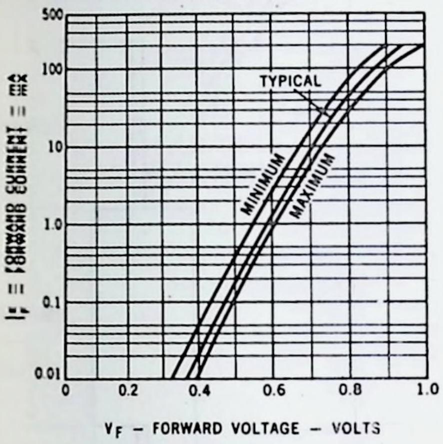
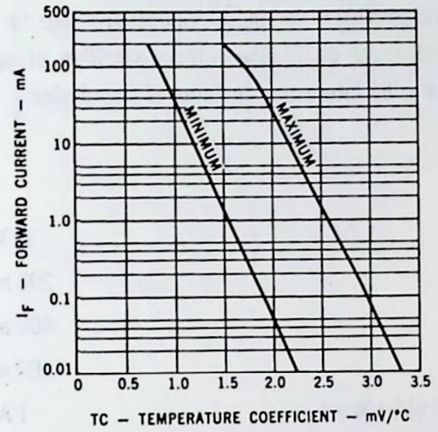
TYPICAL ELECTRICAL CHARACTERISTICS

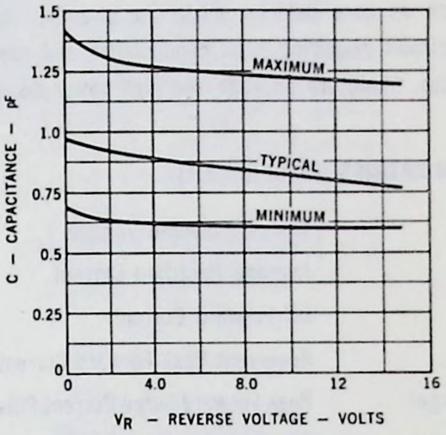
FORWARD VOLTAGE VERSUS FORWARD CURRENT



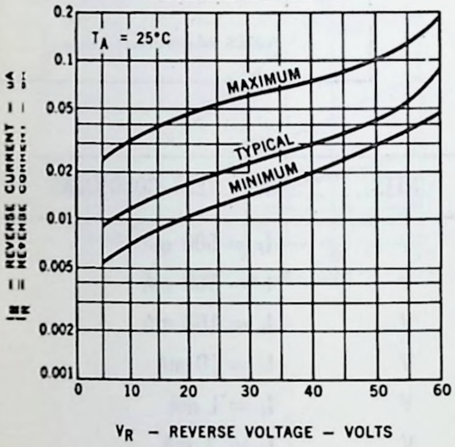
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



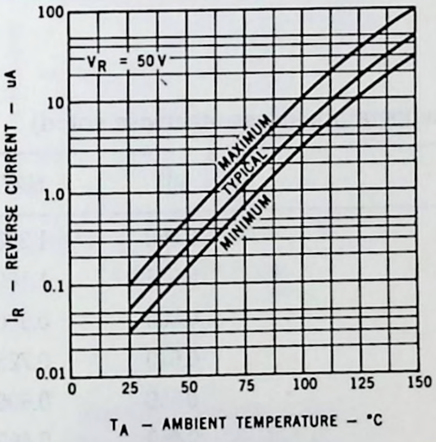
CAPACITANCE VERSUS REVERSE VOLTAGE



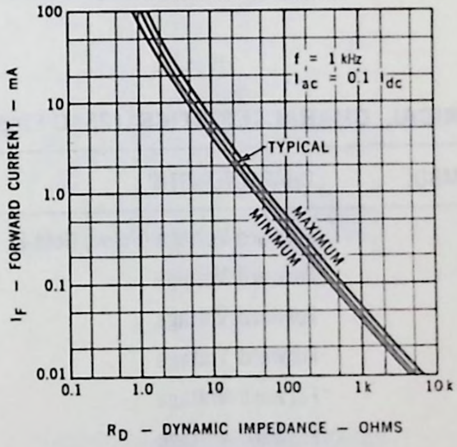
REVERSE VOLTAGE VERSUS REVERSE CURRENT



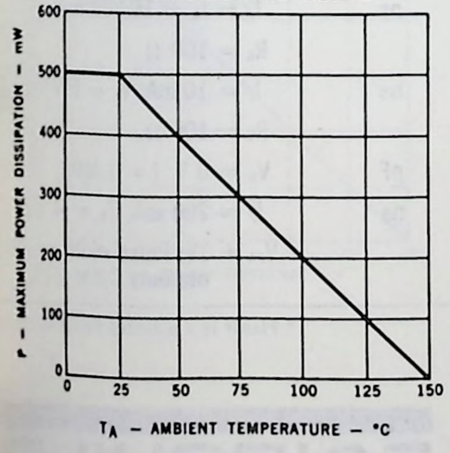
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



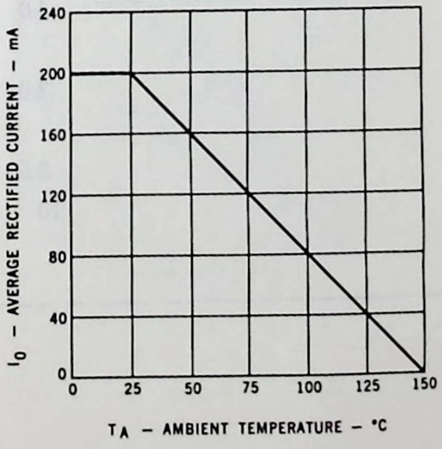
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



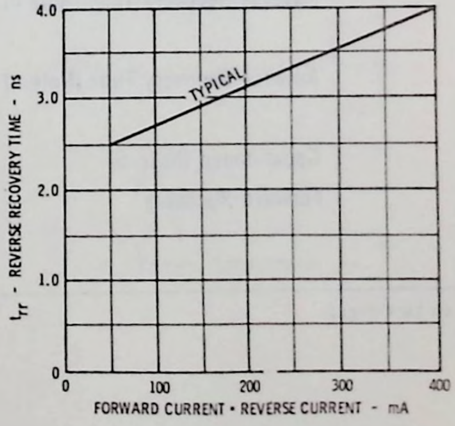
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

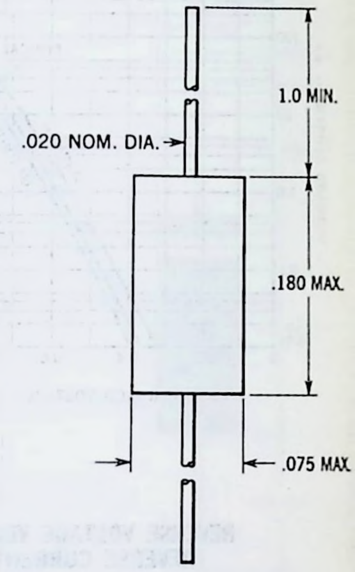


IN5282

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA-FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature IN5282 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	55 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	500 mW
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage [Pulse, Note 3]	0.950	1.300	V	$I_F = 500$ mA
V_F	Forward Voltage	0.875	1.100	V	$I_F = 300$ mA
V_F	Forward Voltage	0.800	0.900	V	$I_F = 100$ mA
V_F	Forward Voltage	0.670	0.725	V	$I_F = 10$ mA
V_F	Forward Voltage	0.550	0.600	V	$I_F = 1$ mA
V_F	Forward Voltage	0.450	0.490	V	$I_F = .1$ mA
I_R	Reverse Current		0.1	μA	$V_R = -55$ V
I_R	Reverse Current (150°C)		100	μA	$V_R = -55$ V
BV	Breakdown Voltage	80			$I_R = 5\ \mu$A
t_{rr}	Reverse Recovery Time [Note 4]		4.0	ns	$I_F = I_R = 10$-200 mA $R_L = 100\ \Omega$
t_{rr}	Reverse Recovery Time [Note 4]		2.0	ns	$I_F = 10$ mA; $V_R = 6$ V $R_L = 100\ \Omega$
C_O	Capacitance [Note 5]		2.5	pF	$V_R = 0$ V, f = 1 MHz
T_{FR}	Forward Recovery		10	ns	$I_F = 200$ mA; $T_R = .4$ ns $V_{FR} = 1$V; Pulse width = 100 ns; Duty Cycle ≤1%

(See notes on back page)

* Planar is a patented Fairchild Process

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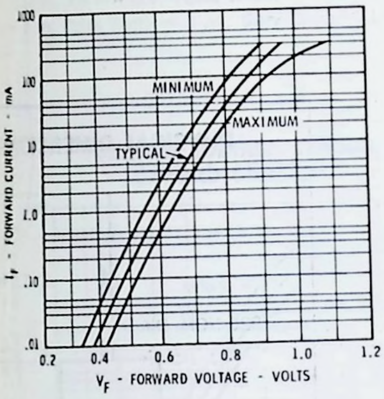
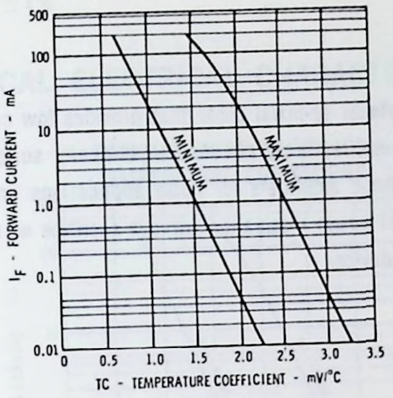
TYPICAL ELECTRICAL CHARACTERISTICS

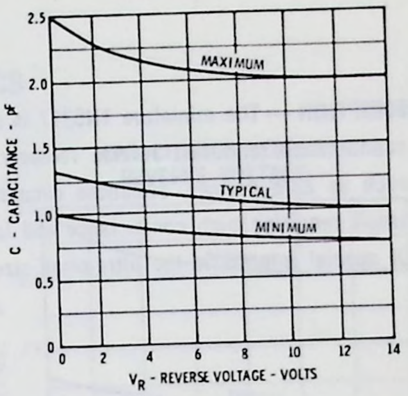
FORWARD VOLTAGE VERSUS FORWARD CURRENT



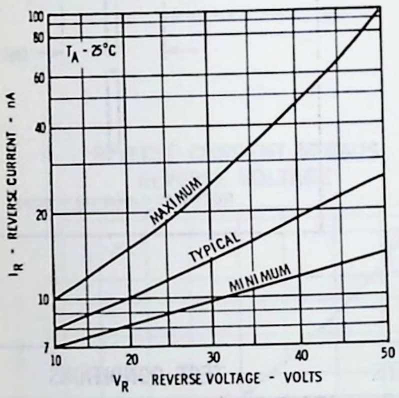
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



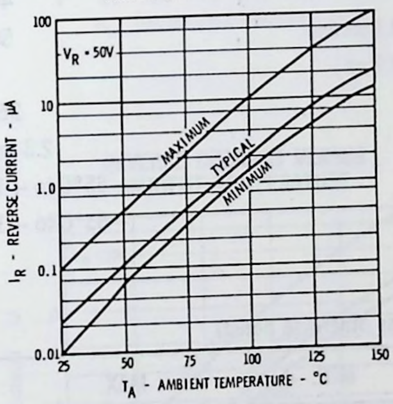
CAPACITANCE VERSUS REVERSE VOLTAGE



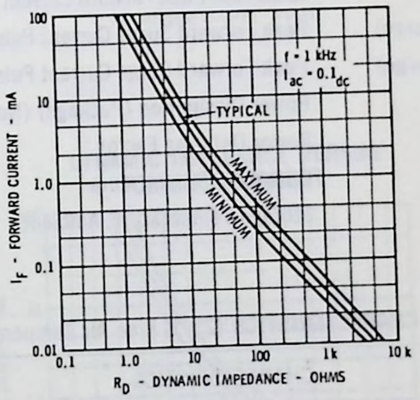
REVERSE CURRENT VERSUS REVERSE VOLTAGE



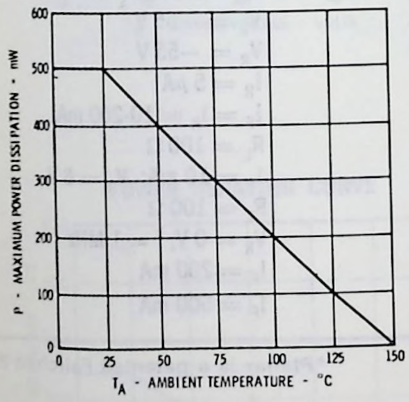
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



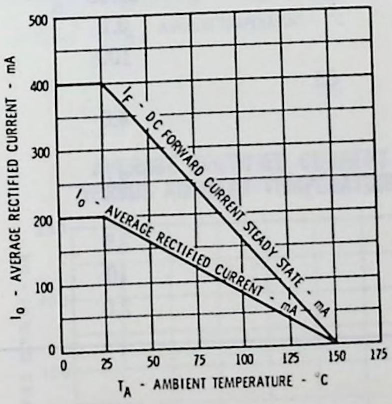
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



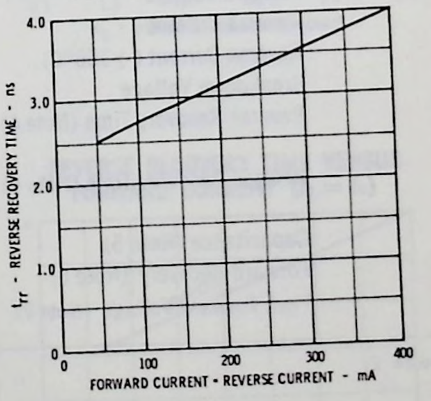
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)



NOTES:

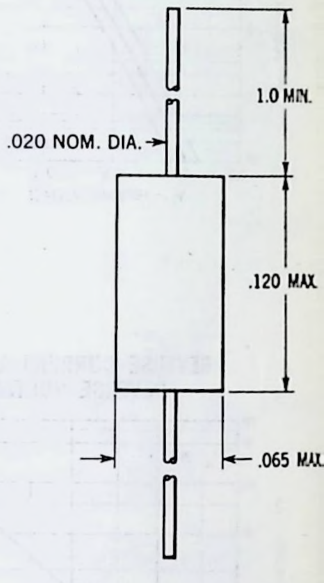
1. Leads are tinned.
2. Heat sunk in copper blocks ¼" from diode body.
3. Pulse width 1 ms, duty cycle ≤1%.
4. Recover to .1 I_F.
5. Capacitance as measured on Boonton Electronic Corporation Model No. 15-AS8 Capacitance Bridge or Equivalent.
6. T_R = 0.4 ns; V_{FR} = 1.0 V; Pulse width = 100 ns; Duty cycle ≤ 1%.

1N5317

ULTRA COMPACT, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N5317 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Of special interest is the ultra-small size of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	55 Volts
I_O	Average Rectified Current	125 mA
i_f	Recurrent Peak Forward Current	400 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	2 A
P	Power Dissipation (Package) (Note 2)	350 mW
$1/\theta$	Power Derating Factor	2.8 mW/°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage (Pulse, Note 3)	1.050	1.300	V	$I_F = 500$ mA
V_F	Forward Voltage	0.920	1.100	V	$I_F = 300$ mA
V_F	Forward Voltage	0.800	0.900	V	$I_F = 100$ mA
V_F	Forward Voltage	0.670	0.725	V	$I_F = 10$ mA
V_F	Forward Voltage	0.550	0.600	V	$I_F = 1.0$ mA
V_F	Forward Voltage	0.450	0.490	V	$I_F = 0.1$ mA
I_R	Reverse Current		0.1	μA	$V_R = -55$ V
I_R	Reverse Current (+150°C)		100	μA	$V_R = -55$ V
BV	Breakdown Voltage	80			$I_R = 5$ μA
t_{rr}	Reverse Recovery Time (Note 4)		4.0	ns	$I_F = I_R = 10$-200 mA $R_L = 100\,\Omega$
t_{rr}	Reverse Recovery Time (Note 4)		2.0	ns	$I_F = 10$ mA; $V_R = 6$ V $R_L = 100\,\Omega$
C_o	Capacitance (Note 5)		2.5	pF	$V_R = 0$ V, f = 1 MHz
T_{FR}	Forward Recovery (Note 6)		10	ns	$I_F = 200$ mA
V_{pK}	Peak Forward Voltage (Note 7)		2.0	V	$I_F = 500$ mA

Notes on page 2.

*Planar is a patented Fairchild Proce

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

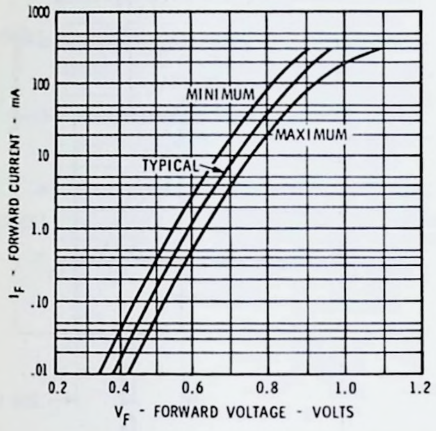
FAIRCHILD DIODE 1N5317

NOTES:

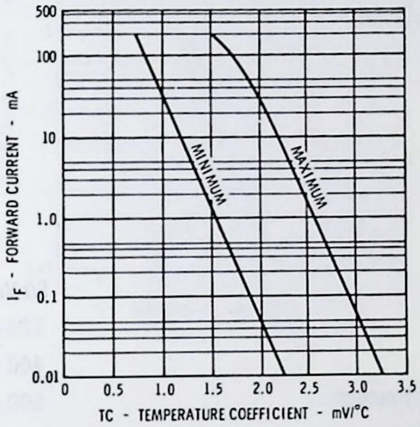
(1) Leads are tinned.
(2) Heat sunk in copper blocks ¼" from diode body.
(3) Pulse width 300 μs; Duty Cycle ≤ 1%.
(4) Recovery to .1 I_R.
(5) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(6) $T_r = .4$ ns, $V_{FR} = 1.0$ V; Pulse Width = 100 ns, Duty Cycle ≤ 1%.
(7) $T_r = 8$ ns; Pulse Width = 1 μs; Duty Cycle ≤ 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

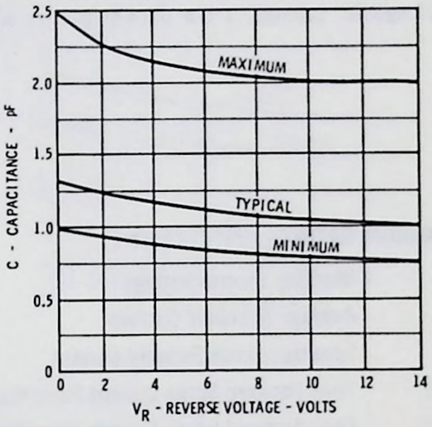
FORWARD VOLTAGE VERSUS FORWARD CURRENT



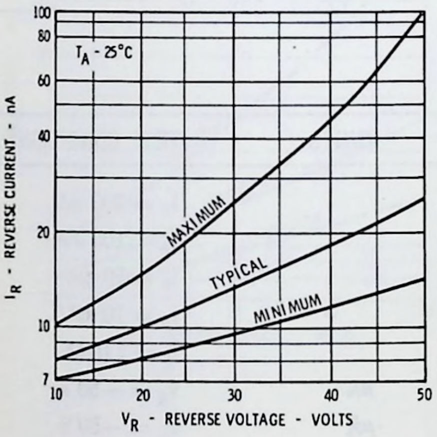
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



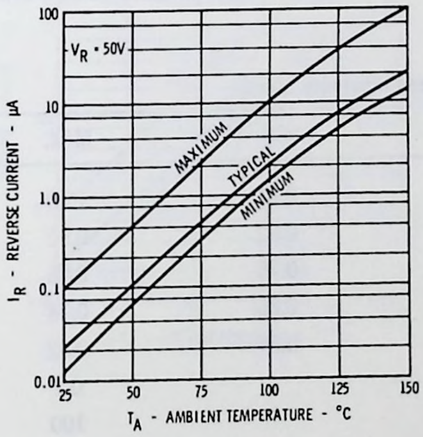
CAPACITANCE VERSUS REVERSE VOLTAGE



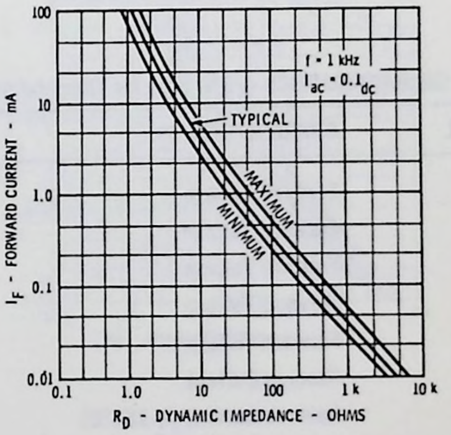
REVERSE CURRENT VERSUS REVERSE VOLTAGE



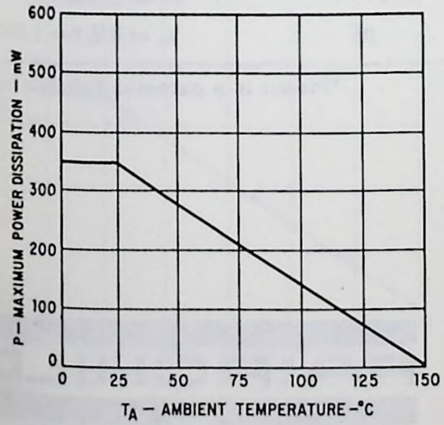
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



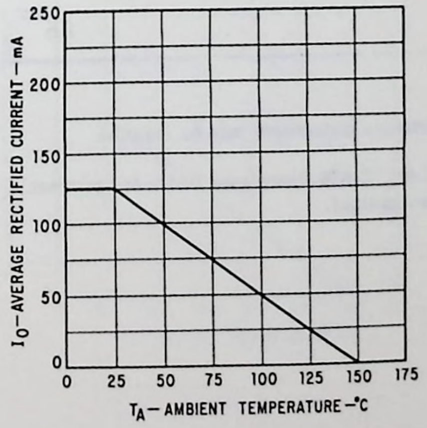
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



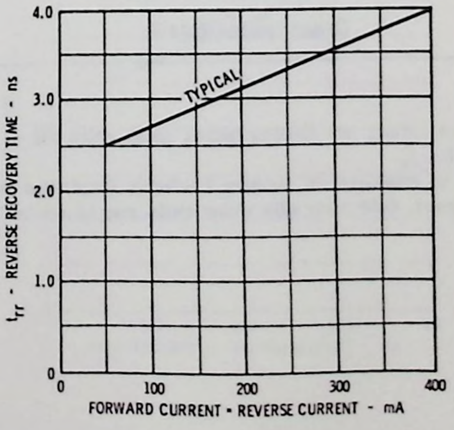
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

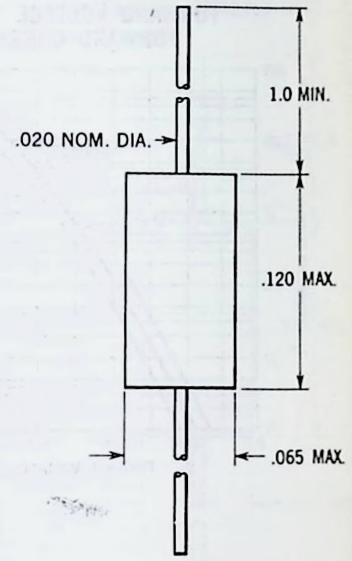


1N5318

ULTRA COMPACT, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N5318 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Of special interest is the ultra-small size of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	50 Volts
I_O	Average Rectified Current	125 mA
i_f	Recurrent Peak Forward Current	400 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	2 A
P	Power Dissipation (Package)	350 mW
$1/\theta$	Power Derating Factor	2.8 mW/°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage	0.87	1.00		$I_F = 200$ mA
V_F	Forward Voltage	0.82	0.92		$I_F = 100$ mA
V_F	Forward Voltage	0.76	0.86		$I_F = 50$ mA
V_F	Forward Voltage	0.66	0.74		$I_F = 10$ mA
V_F	Forward Voltage	0.54	0.62		$I_F = 1.0$ mA
I_R	Reverse Current		0.1	μA	$V_R = -50$ V
I_R	Reverse Current (+150°C)		100	μA	$V_R = -50$ V
BV	Breakdown Voltage	75			$I_R = 5$ μA
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$-200 mA $R_L = 100\ \Omega$
t_{rr}	Reverse Recovery Time (Note 2)		6.0	ns	$I_F = I_R = 200$-400 mA $R_L = 100\ \Omega$
C_o	Capacitance (Note 3)		2.5	pF	$V_R = 0$ V, f = 1 MHz

*Planar is a patented Fairchild Process

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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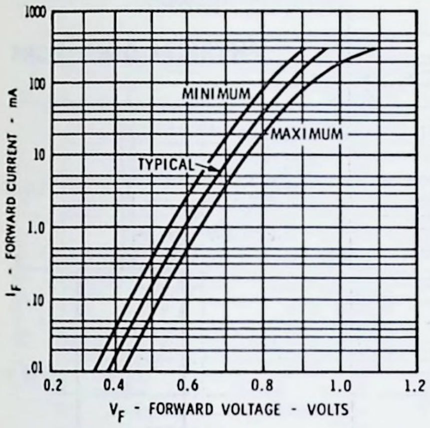
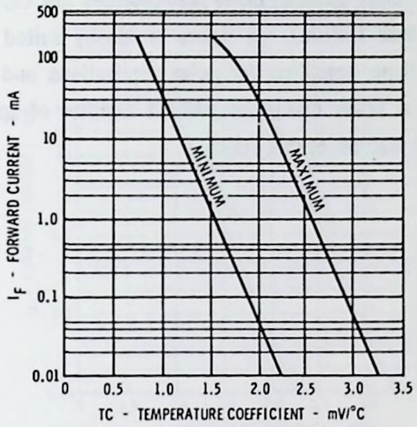
FAIRCHILD DIODE 1N5318

TYPICAL ELECTRICAL CHARACTERISTICS

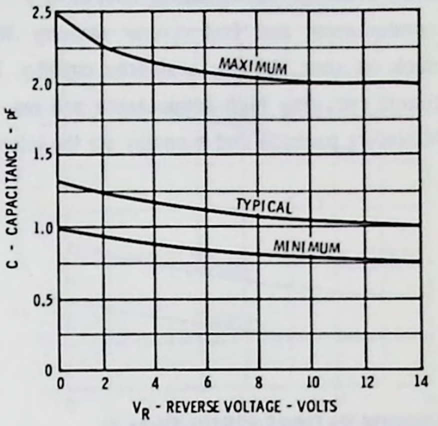
FORWARD VOLTAGE VERSUS FORWARD CURRENT



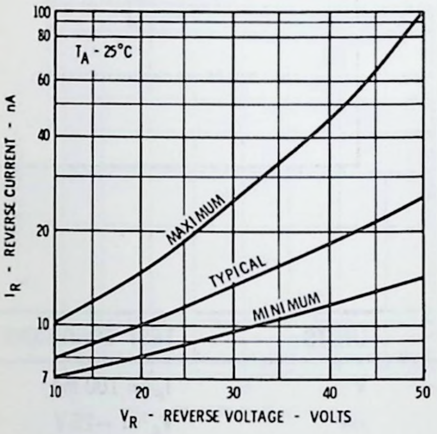
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



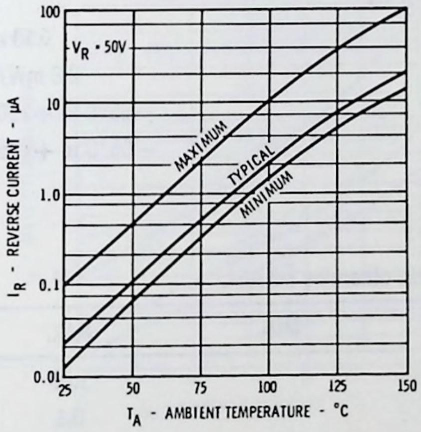
CAPACITANCE VERSUS REVERSE VOLTAGE



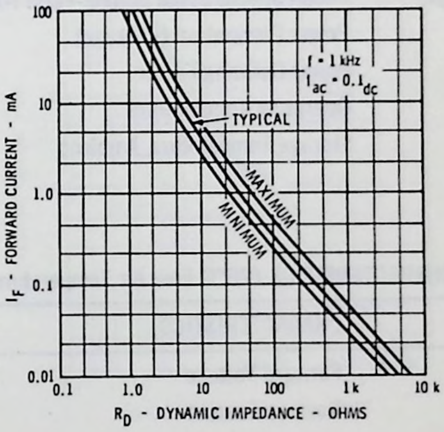
REVERSE CURRENT VERSUS REVERSE VOLTAGE



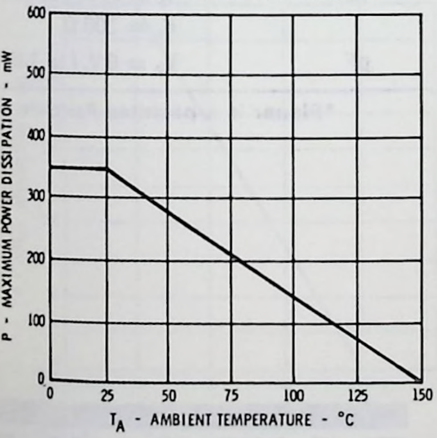
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



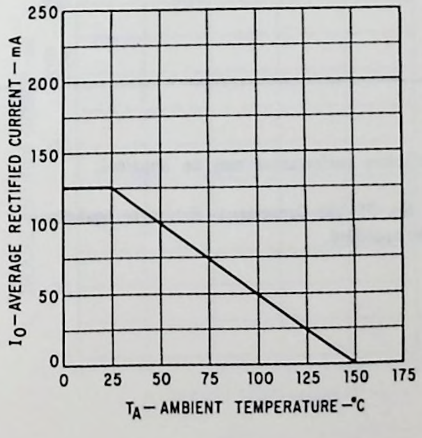
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



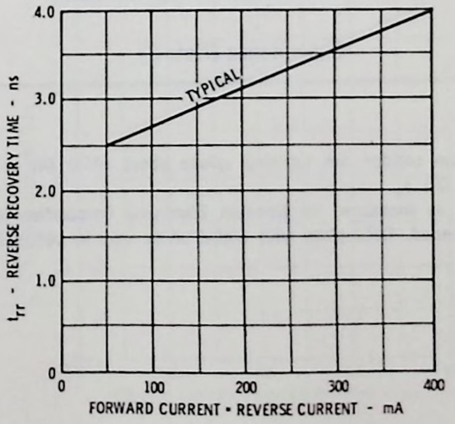
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

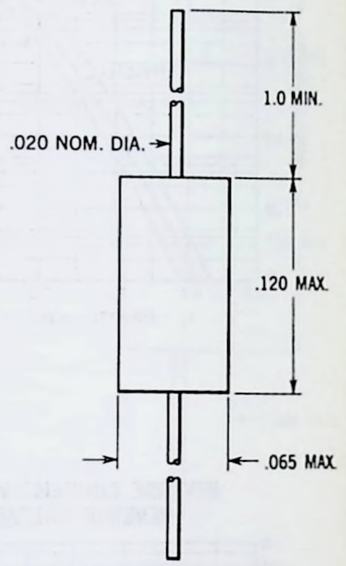


1N5319

ULTRA COMPACT, HIGH CONDUCTANCE, ULTRA FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature 1N5319 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core drivers, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and economy are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	25 Volts
I_O	Average Rectified Current	100 mA
i_f	Recurrent Peak Forward Current	400 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	2 A
P	Power Dissipation (Package)	350 mW
$1/\theta$	Power Derating Factor	2.8 mW/°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.00	V	$I_F = 100$ mA
I_R	Reverse Current		0.1	μA	$V_R = -25$ V
I_R	Reverse Current (+100°C)		100	μA	$V_R = -25$ V
BV	Breakdown Voltage	40		V	$I_R = 5$ μA
t_{rr1}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$-200 mA $R_L = 100\,\Omega$
t_{rr2}	Reverse Recovery Time (Note 2)		6.0	ns	$I_F = I_R = 200$-400 mA $R_L = 100\,\Omega$
C_o	Capacitance (Note 3)		3.5	pF	$V_R = 0$ V, f = 1 MHz

*Planar is a patented Fairchild Process

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_R.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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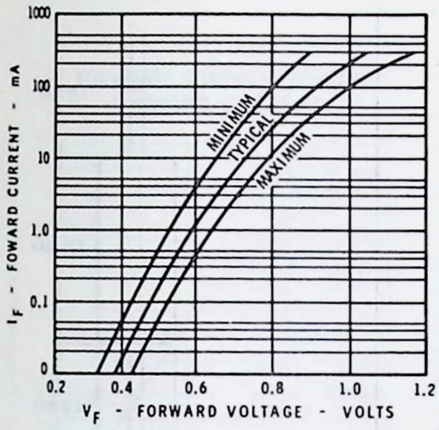
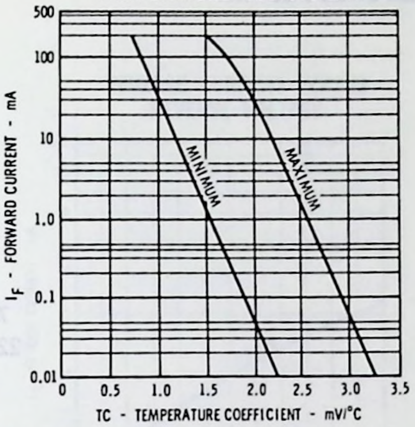
TYPICAL ELECTRICAL CHARACTERISTICS

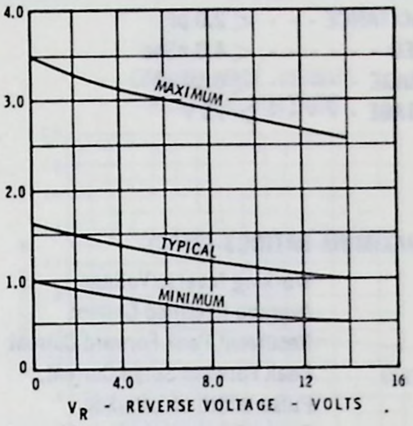
FORWARD VOLTAGE VERSUS FORWARD CURRENT



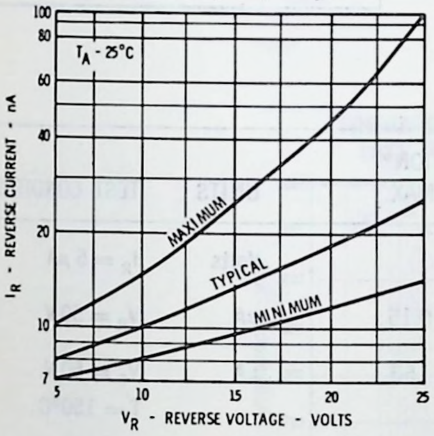
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



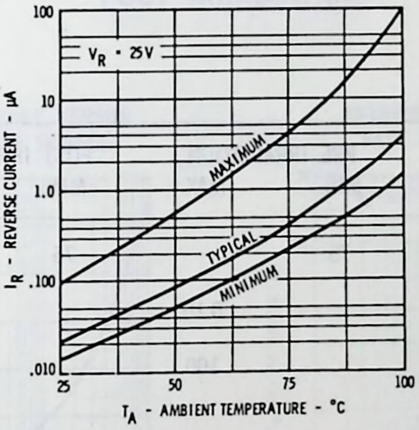
CAPACITANCE VERSUS REVERSE VOLTAGE



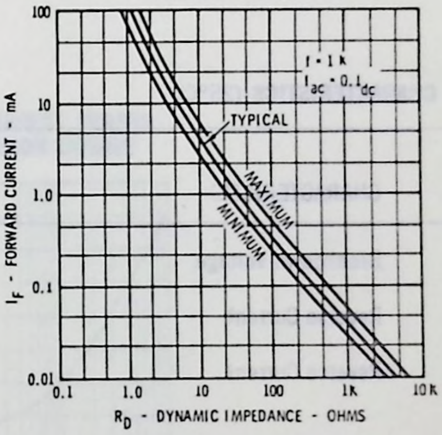
REVERSE CURRENT VERSUS REVERSE VOLTAGE



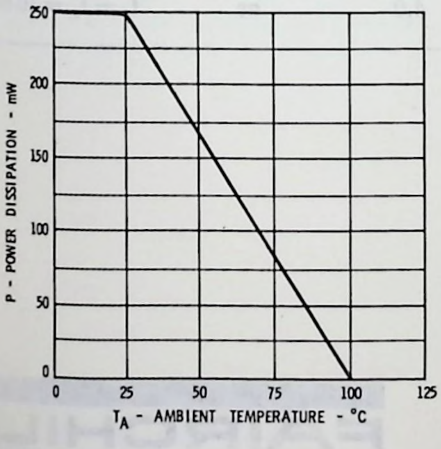
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



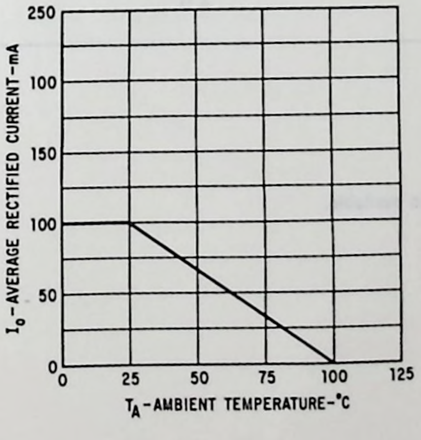
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



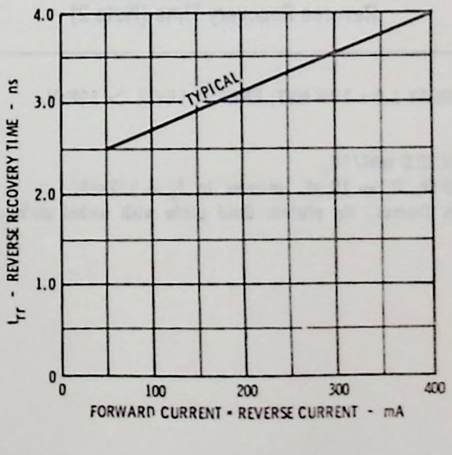
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

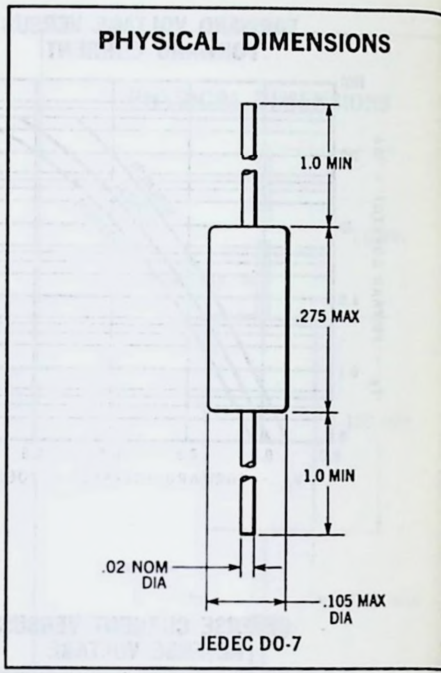


1N5427

RADIATION RESISTANT, FAST SWITCHING, PLANAR* DIODE

FEATURES

- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE OF 1.0 x 10^{15} NVT**
- **LOW CAPACITANCE - - - $<$ 2.0 pF**
- **HIGH SPEED - - - - - - - $<$ 4.0 nSec**
- **LOW LEAKAGE - - - - - - $<$ 0.10 μA**
- **HIGH VOLTAGE - - - - - $>$ 75 V**



ABSOLUTE MAXIMUM RATINGS (25°C)

WIV	Working Inverse Voltage	50 V
I_o	Average Rectified Current	75 mA
i_f	Recurrent Peak Forward Current	225 mA
i_f(surge)	Peak Forward Surge Current, Pulse Width of 1.0 μSec.	2.0 A
P	Power Dissipation (Note 1)	250 mW
T_J	Operating Junction Temperature	−65°C to 150°C
T_A	Ambient Storage Temperature	−65°C to 175°C

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	PRE IRRADIATION MIN.	PRE IRRADIATION MAX.	POST IRRADIATION* MIN.	POST IRRADIATION* MAX.	UNITS	TEST CONDITIONS
B_v	Breakdown Voltage	75		75		Volts	$I_R = 5\ \mu A$
I_{R1}	Reverse Current		0.10		0.15	μA	$V_R = 50$ V
I_{R2}	Reverse Current		100		150	μA	$V_R = 50$ V, T = 150°C
V_F	Forward Voltage		1.0		1.3	Volts	$I_F = 10$ mA
C	Capacitance		2.0		2.0	pF	$V_R = 0$ V, f = 1 MHz
T_{RR}	Reverse Recovery Time (Note 2)		4.0		4.0	ns	$I_F = I_R = 10$ mA

***IRRADIATION AT 1.0 x 10^{15} NVT, ENERGY LEVEL $>$ 10KeV.**

NOTES:

(1) Derate at 2.0 mW/°C.
(2) $R_L = 100\ \Omega$, $C_L = 10$ pF, recover to $I_R = 1.0$ mA.
(3) Leads are Dumet, tin plated. Gold plate with nickel strike is also available.

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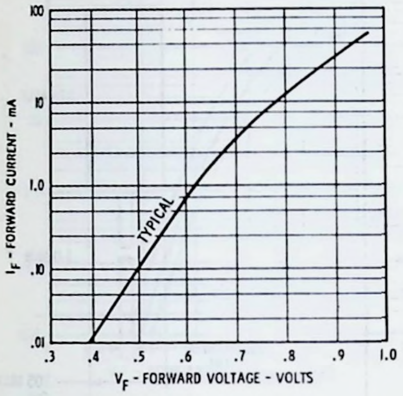
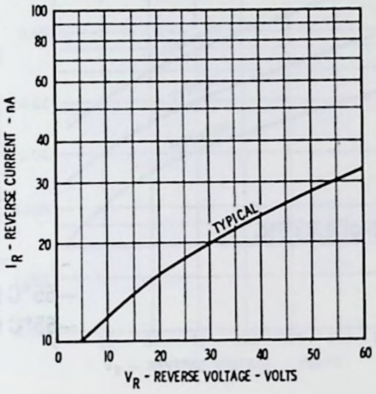
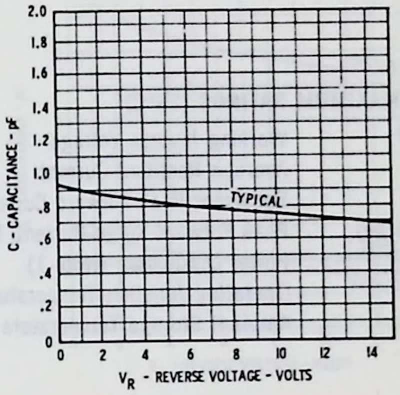
TYPICAL ELECTRICAL CHARACTERISTICS

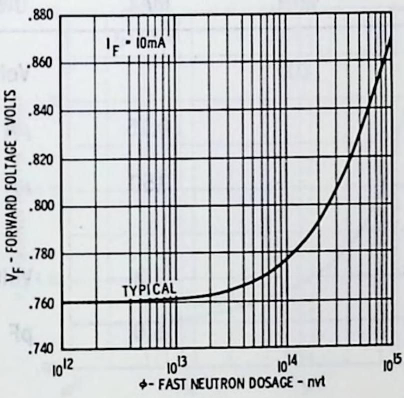
PRE IRRADIATION

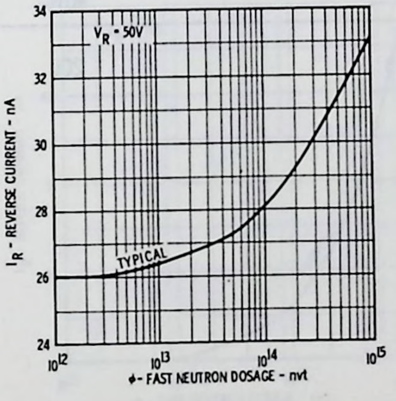

FORWARD VOLTAGE VERSUS FORWARD CURRENT


REVERSE CURRENT VERSUS REVERSE VOLTAGE


CAPACITANCE VERSUS REVERSE VOLTAGE

POST IRRADIATION


FORWARD VOLTAGE VERSUS FAST NEUTRON DOSAGE

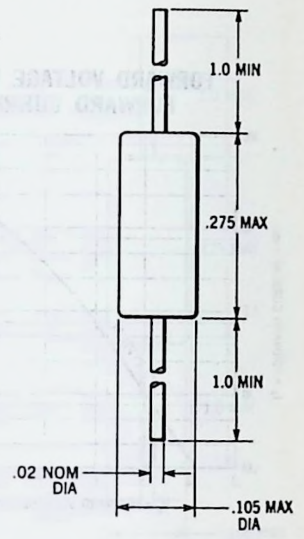

REVERSE CURRENT VERSUS FAST NEUTRON DOSAGE

1N5428
RADIATION RESISTANT, HIGH VOLTAGE, FAST SWITCHING, PLANAR* DIODE

FEATURES

- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE OF 3.0 x 10^{14} NVT**
- **HIGH VOLTAGE - - - - - - > 200 V**
- **LOW LEAKAGE - - - - - - - < 0.10 μA**
- **HIGH CONDUCTANCE - - - > 100 mA**
- **LOW CAPACITANCE - - - - < 5.0 pF**

PHYSICAL DIMENSIONS



JEDEC DO-7

ABSOLUTE MAXIMUM RATINGS (25°C)

WIV	Working Inverse Voltage	175 V
I_o	Average Rectified Current	100 mA
i_f	Recurrent Peak Forward Current	300 mA
i_f(surge)	Peak Forward Surge Current, Pulse Width of 1.0 μSec.	4.0 A
P	Power Dissipation (Note 1)	500 mW
T_J	Operating Junction Temperature	−65°C to 150°C
T_A	Ambient Storage Temperature	−65°C to 175°C

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	PRE IRRADIATION MIN.	MAX.	POST IRRADIATION* MIN.	MAX.	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	200		200		Volts	$I_R = 100$ μA
I_{R1}	Reverse Current		0.10		0.15	μA	$V_R = 175V$
I_{R2}	Reverse Current		100		150	μA	$V_R = 175V$, $T = 150°C$
V_F	Forward Voltage		1.0		1.3	Volts	$I_F = 100$ mA
C	Capacitance		5.0		5.0	pF	$V_R = 0$ V, f = 1 MHz
T_{RR}	Reverse Recovery Time (Note 2)		50		50	ns	$I_F = I_R = 30$ mA

*IRRADIATION AT 3.0 x 10^{14} NVT, ENERGY LEVEL > 10KeV.

NOTES:

(1) Derate at 4.0 mW/°C.
(2) $R_L = 100\ \Omega$, $C_L = 10$ pF, recover to $I_R = 3.0$ mA.
(3) Leads are Dumet, tin plated. Gold plate with nickel strike is also available.

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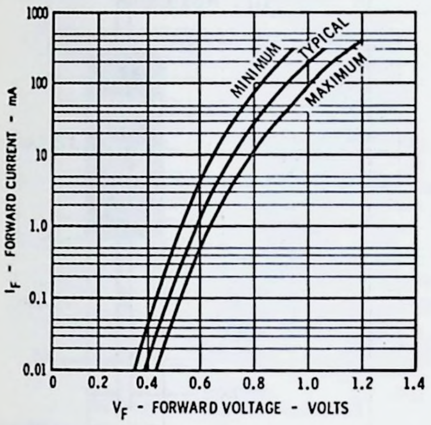
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

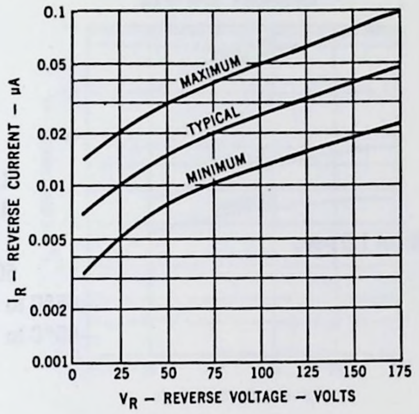
TYPICAL ELECTRICAL CHARACTERISTICS

PRE IRRADIATION

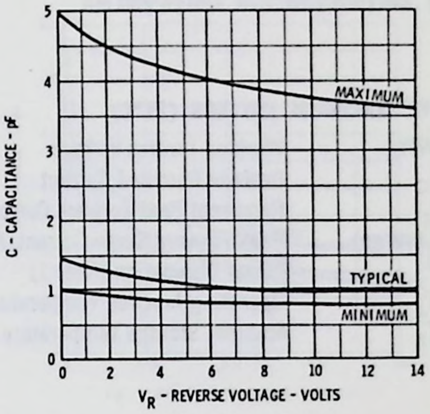
FORWARD VOLTAGE VERSUS FORWARD CURRENT



REVERSE VOLTAGE VERSUS REVERSE CURRENT

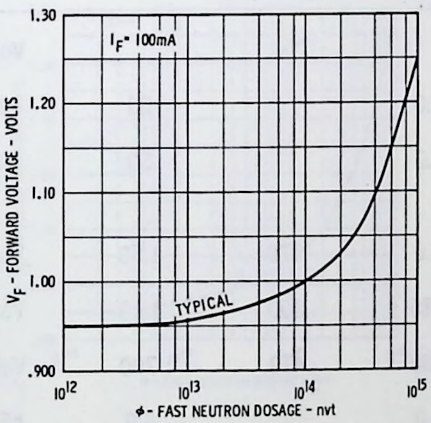


CAPACITANCE VERSUS REVERSE VOLTAGE

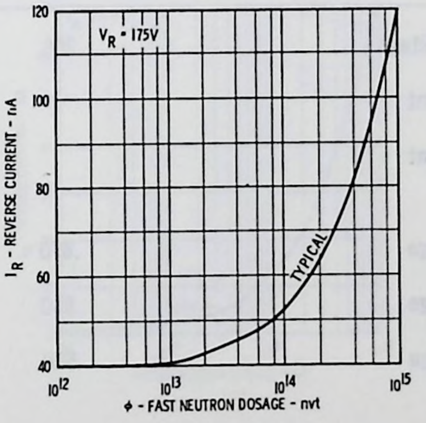


POST IRRADIATION

FORWARD VOLTAGE VERSUS FAST NEUTRON DOSAGE



REVERSE CURRENT VERSUS FAST NEUTRON DOSAGE



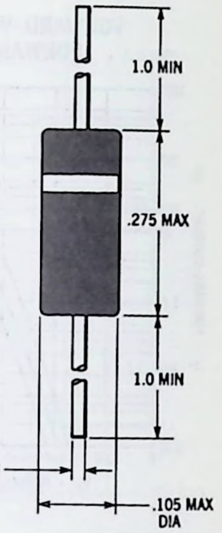
1N5429

RADIATION RESISTANT, LOW LEAKAGE, HIGH CONDUCTANCE, PLANAR* DIODE

FEATURES

- GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE OF 3.0 x 10^{14} NVT
- LOW LEAKAGE - - - - - - - - $<$ 5.0 nA
- HIGH VOLTAGE - - - - - - - $>$ 200 V
- LOW CAPACITANCE - - - - $<$ 6.0 pF
- HIGH CONDUCTANCE - - - $>$ 200 mA

PHYSICAL DIMENSIONS



JEDEC DO-7

ABSOLUTE MAXIMUM RATINGS (25°C)

WIV	Working Inverse Voltage	125 V
I_O	Average Rectified Current	150 mA
i_f	Recurrent Peak Forward Current	450 mA
i_f(surge)	Peak Forward Surge Current, Pulse Width of 1.0 μsec.	4.0 A
P	Power Dissipation (Note 1)	500 mW
T_J	Operating Junction Temperature	−65°C to 150°C
T_A	Ambient Storage Temperature	−65°C to 175°C

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	PRE IRRADIATION MIN	PRE IRRADIATION MAX	POST IRRADIATION* MIN	POST IRRADIATION* MAX	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	200		200		Volts	$I_R = 100\ \mu A$
I_{R1}	Reverse Current		5.0		50	nA	$V_R = 125$ V
I_{R2}	Reverse Current		3.0		50	μA	$V_R = 125$ V, $T = 150°C$
V_{F1}	Forward Voltage	.870	1.0	.870	1.50	Volts	$I_F = 200$ mA
V_{F2}	Forward Voltage	.800	.880	.800	1.10	Volts	$I_F = 50$ mA
V_{F3}	Forward Voltage	.580	.680	.470	.700	Volts	$I_F = 1.0$ mA
C	Capacitance		6.0		6.0	pF	$V_R = 0$ V, f = 1 MHz

*IRRADIATION AT 3.0 x 10^{14} NVT, ENERGY LEVEL $>$ 10KeV.

NOTES:

(1) Derate at 4.0 mW/°C.

(2) Leads are Dumet, tin plated. Gold plate with nickel strike is also available.

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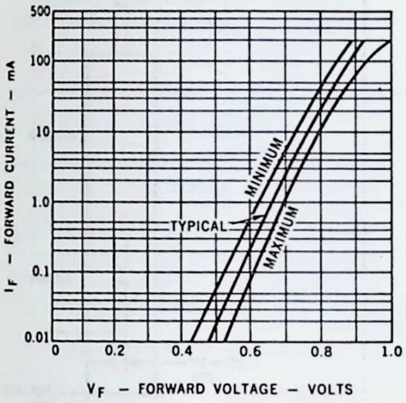
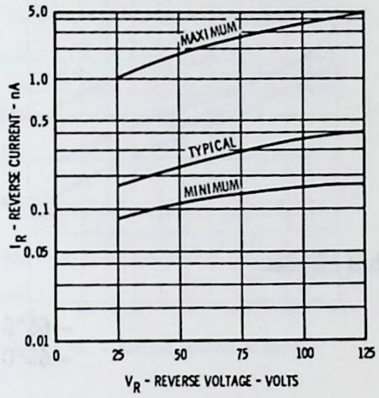
TYPICAL ELECTRICAL CHARACTERISTICS

PRE IRRADIATION

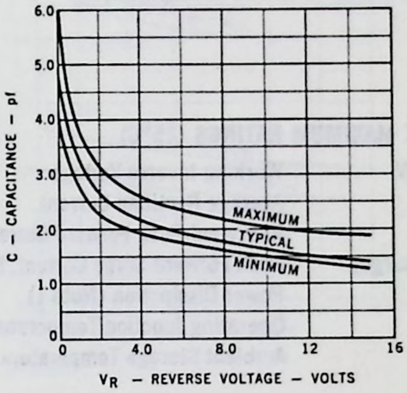
FORWARD VOLTAGE VERSUS FORWARD CURRENT



REVERSE VOLTAGE VERSUS REVERSE CURRENT

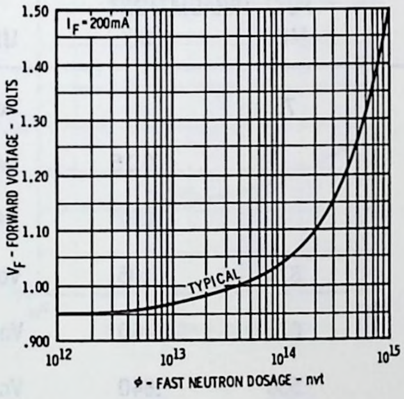


CAPACITANCE VERSUS REVERSE VOLTAGE

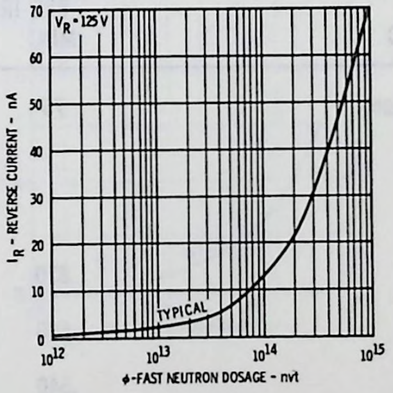


POST IRRADIATION

FORWARD VOLTAGE VERSUS FAST NEUTRON DOSAGE



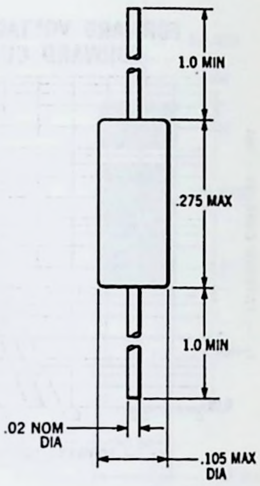
REVERSE CURRENT VERSUS FAST NEUTRON DOSAGE



1N5430
RADIATION RESISTANT, HIGH CONDUCTANCE, ULTRA FAST, PLANAR* EPITAXIAL DIODE

FEATURES
- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE OF 1.0 x 10^{15} NVT.**
- **HIGH CONDUCTANCE - - - > 200 mA**
- **LOW CAPACITANCE - - - - < 2.5 pF**
- **HIGH SPEED - - - - - - - - - < 4.0 ns**
- **LOW LEAKAGE - - - - - - - - < 0.10 μA**

PHYSICAL DIMENSIONS



JEDEC DO-7

ABSOLUTE MAXIMUM RATINGS (25°C)

WIV	Working Inverse Voltage	50 V
I_o	Average Rectified Current	200 mA
i_f	Recurrent Peak Forward Current	900 mA
i_f(surge)	Peak Forward Surge Current, Pulse Width of 1.0 μSec.	4.0 A
P	Power Dissipation (Note 1)	500 mW
T_J	Operating Junction Temperature	−65°C to 150°C
T_A	Ambient Storage Temperature	−65°C to 175°C

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	PRE IRRADIATION		POST IRRADIATION*		UNITS	TEST CONDITIONS
		MIN.	MAX.	MIN.	MAX.		
B_v	Breakdown Voltage	75		75		Volts	$I_R = 5$ μA
I_{R1}	Reverse Current		0.10		0.15	μA	$V_R = 50$ V
I_{R2}	Reverse Current		100		150	μA	$V_R = 50$ V, T = 150°C
V_{F1}	Forward Voltage	.870	1.0	.870	1.05	Volts	$I_F = 200$ mA
V_{F2}	Forward Voltage	.660	.740	.620	.760	Volts	$I_F = 10$ mA
V_{F3}	Forward Voltage	.540	.620	.500	.640	Volts	$I_F = 1.0$ mA
C	Capacitance		2.5		2.5	pF	$V_R = 0$ V, f = 1 MHz
T_{RR}	Reverse Recovery Time (Note 2)		4.0		4.0	ns	$I_F = I_R = 10$ mA

*IRRADIATION AT 1.0 x 10^{15} NVT, ENERGY LEVEL > 10 KeV.

NOTES:
(1) Derate at 4.0 mW/°C.
(2) $R_L = 100\ \Omega$, recover to $I_R = 1.0$ mA.
(3) Leads are Dumet, tin plated. Gold plate with nickel strike is also available.

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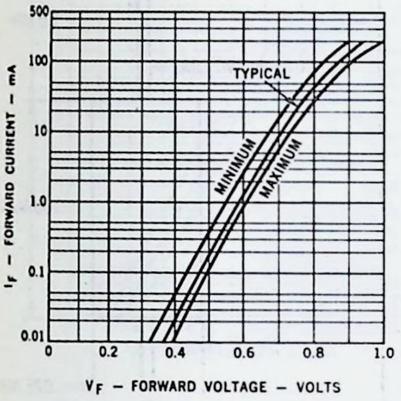
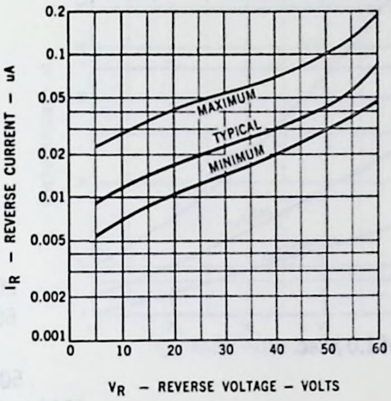
TYPICAL ELECTRICAL CHARACTERISTICS

PRE IRRADIATION

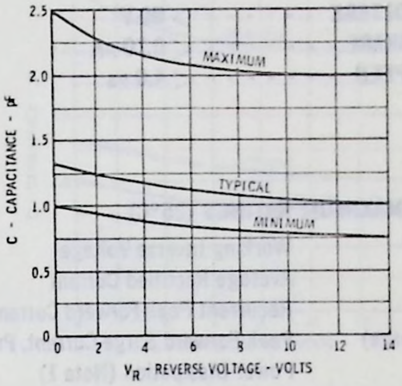
FORWARD VOLTAGE VERSUS FORWARD CURRENT



REVERSE VOLTAGE VERSUS REVERSE CURRENT

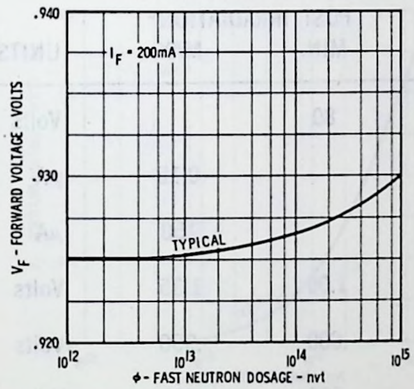


CAPACITANCE VERSUS REVERSE VOLTAGE

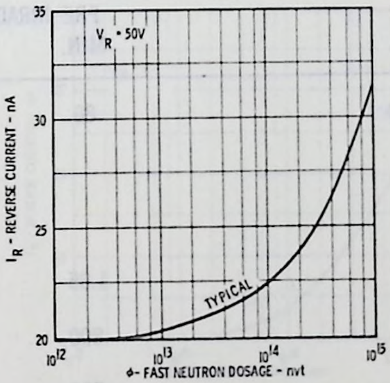


POST IRRADIATION

FORWARD VOLTAGE VERSUS FAST NEUTRON DOSAGE



REVERSE CURRENT VERSUS FAST NEUTRON DOSAGE



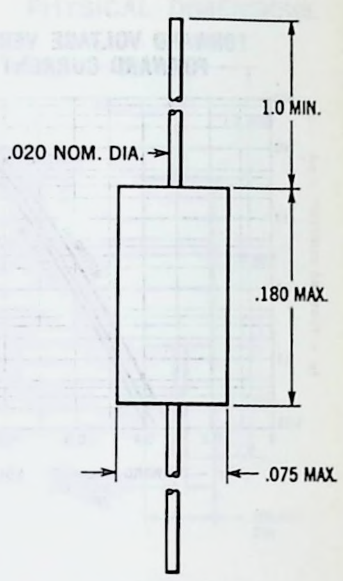
1N5431

RADIATION RESISTANT, MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA FAST, PLANAR* EPITAXIAL DIODE

FEATURES

- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE OF 1.0 x 10^{15} NVT.**
- **SMALL PACKAGE - - - - - - JEDEC DO-35**
- **HIGH CONDUCTANCE - - - > 500 mA**
- **LOW CAPACITANCE - - - - < 2.5 pF**
- **HIGH VOLTAGE - - - - - - > 80 V**
- **LOW LEAKAGE - - - - - - - < 0.10 μA**
- **HIGH SPEED - - - - - - - < 4.0 ns**

PHYSICAL DIMENSIONS



JEDEC DO-35

ABSOLUTE MAXIMUM RATINGS (25°C)

WIV	Working Inverse Voltage	55 V
I_o	Average Rectified Current	200 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current, Pulse Width of 1.0 μSec.	4.0 A
P	Power Dissipation (Note 1)	500 mW
T_J	Operating Junction Temperature	−65°C to 150°C
T_A	Ambient Storage Temperature	−65°C to 175°C

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	PRE IRRADIATION		POST IRRADIATION*		UNITS	TEST CONDITIONS
		MIN.	MAX.	MIN.	MAX.		
B_V	Breakdown Voltage	80		80		Volts	$I_R = 5\ \mu A$
I_{R1}	Reverse Current		0.10		0.15	μA	$V_R = 55$ V
I_{R2}	Reverse Current		100		150	μA	$V_R = 55$ V, T = 150°C
V_{F1}	Forward Voltage	1.05	1.30	1.05	1.35	Volts	$I_F = 500$ mA (Note 2)
V_{F2}	Forward Voltage	.800	.900	.800	.950	Volts	$I_F = 100$ mA
V_{F3}	Forward Voltage	.550	.600	.520	.630	Volts	$I_F = 1.0$ mA
V_{F4}	Forward Voltage	.450	.490	.420	.520	Volts	$I_F = 0.1$ mA
C	Capacitance		2.5		2.5	pF	$V_R = 0$ V, f = 1 MHz
T_{RR}	Reverse Recovery Time		4.0		4.0	ns	$I_F = I_R = 10$ mA (Note 3)

*IRRADIATION AT 1.0 x 10^{15} NVT, ENERGY LEVEL > 10 KeV.

NOTES:

(1) Derate at 4.0 mW/°C.
(2) Pulse width 300 μSec, duty cycle < 1%.
(3) $R_L = 100\ \Omega$, recover to $I_R = 1.0$ mA.
(4) Leads are Dumet, tin plated. Gold plate with nickel strike is also available.

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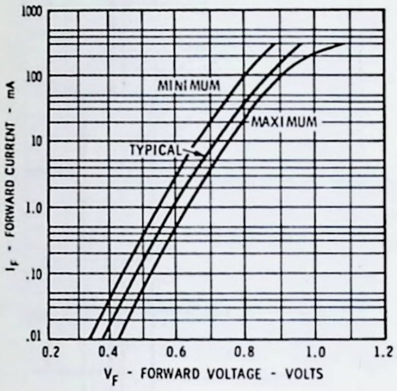
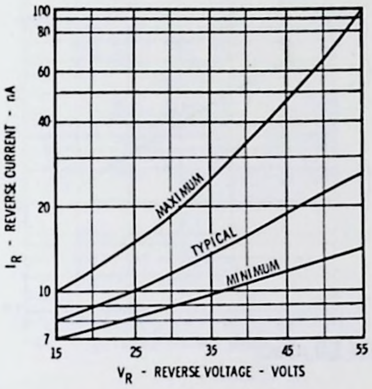
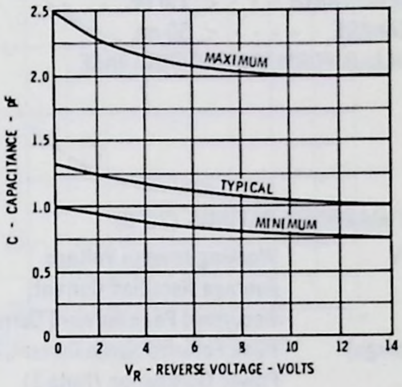
TYPICAL ELECTRICAL CHARACTERISTICS

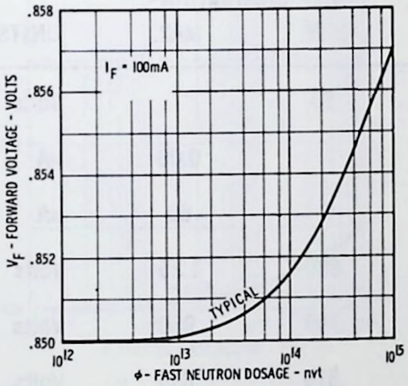
PRE IRRADIATION

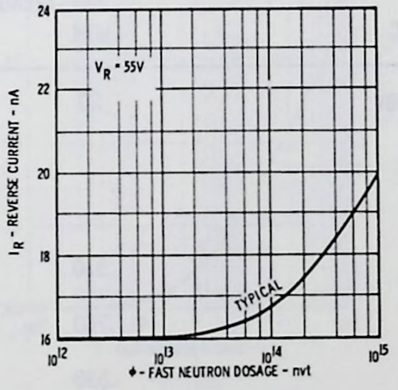

FORWARD VOLTAGE VERSUS FORWARD CURRENT


REVERSE CURRENT VERSUS REVERSE VOLTAGE


CAPACITANCE VERSUS REVERSE VOLTAGE

POST IRRADIATION


FORWARD VOLTAGE VERSUS FAST NEUTRON DOSAGE


REVERSE CURRENT VERSUS FAST NEUTRON DOSAGE

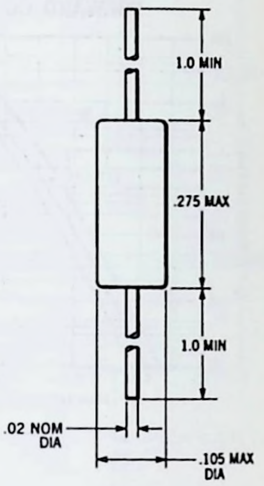
1N5432

RADIATION RESISTANT, PICOSECOND SWITCHING, PLANAR* EPITAXIAL DIODE

FEATURES

- **GUARANTEED PERFORMANCE AFTER FAST NEUTRON DOSAGE OF 1.0 x 10^{15} NVT.**
- **HIGH SPEED - - - - - - - < 750 ps**
- **LOW CAPACITANCE - - - < 1.0 pF**
- **LOW LEAKAGE - - - - - - < 50 nA**
- **CONTROLLED FORWARD CONDUCTANCE**

PHYSICAL DIMENSIONS



JEDEC DO-7

ABSOLUTE MAXIMUM RATINGS (25°C)

WIV	Working Inverse Voltage	10 V
I_o	Average Rectified Current	50 mA
i_f	Recurrent Peak Forward Current	150 mA
i_f(surge)	Peak Forward Surge Current, Pulse Width of 1.0 μSec.	1.0 A
P	Power Dissipation (Note 1)	250 mW
T_J	Operating Junction Temperature	−65°C to 150°C
T_A	Ambient Storage Temperature	−65°C to 175°C

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	PRE IRRADIATION MIN.	PRE IRRADIATION MAX.	POST IRRADIATION* MIN.	POST IRRADIATION* MAX.	UNITS	TEST CONDITIONS
B_v	Breakdown Voltage	20		20		Volts	$I_R = 5\ \mu A$
I_{R1}	Reverse Current		0.05		0.06	μA	$V_R = 10$ V
I_{R2}	Reverse Current		50		60	μA	$V_R = 10$ V, T = 150°C
V_{F1}	Forward Voltage	.910	1.30	.890	1.35	Volts	$I_F = 50$ mA
V_{F2}	Forward Voltage	.760	.930	.740	.950	Volts	$I_F = 10$ mA
V_{F3}	Forward Voltage	.530	.610	.510	.630	Volts	$I_F = 0.1$ mA
C	Capacitance		1.0		1.0	pF	$V_R = 0$ V, f = 1 MHz
T_{RR}	Reverse Recovery Time (Note 2)		750		750	ps	$I_F = I_R = 10$ mA (Figure 1)

*IRRADIATION AT 1.0 x 10^{15} NVT, ENERGY LEVEL > 10 KeV.

NOTES:
(1) Derate at 2.0 mW/°C.
(2) $R_L = 100\ \Omega$, recover to $I_R = 1.0$ mA. (See Figure 1 over.)
(3) Leads are Dumet, tin plated. Gold plate with nickel strike is also available.

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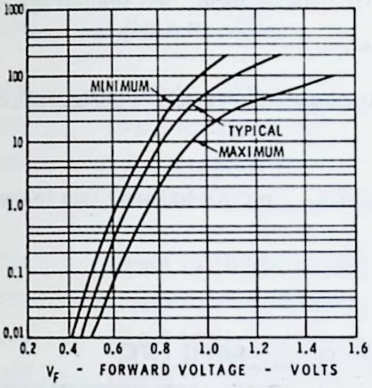
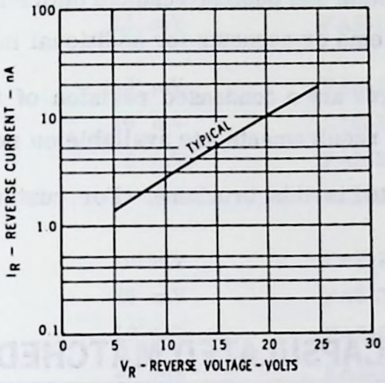
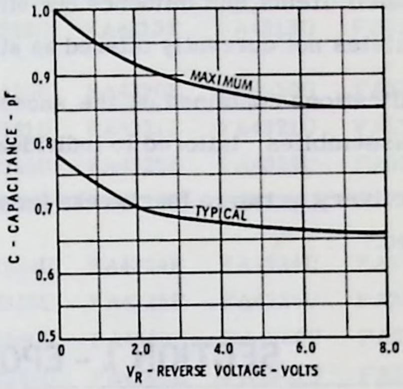
TYPICAL ELECTRICAL CHARACTERISTICS

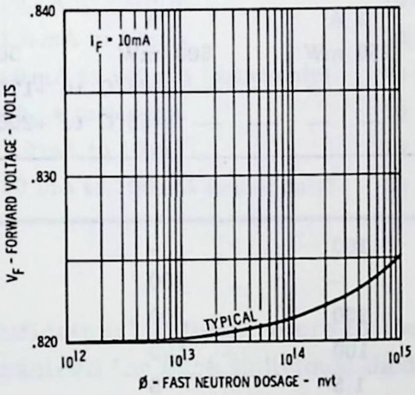
PRE IRRADIATION

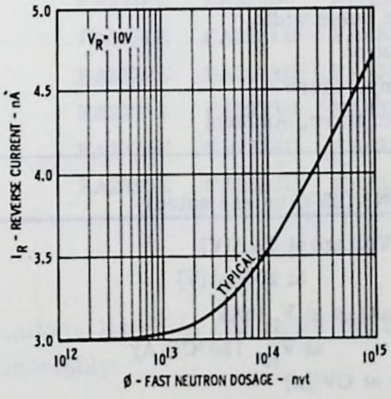

FORWARD CURRENT VERSUS FORWARD VOLTAGE

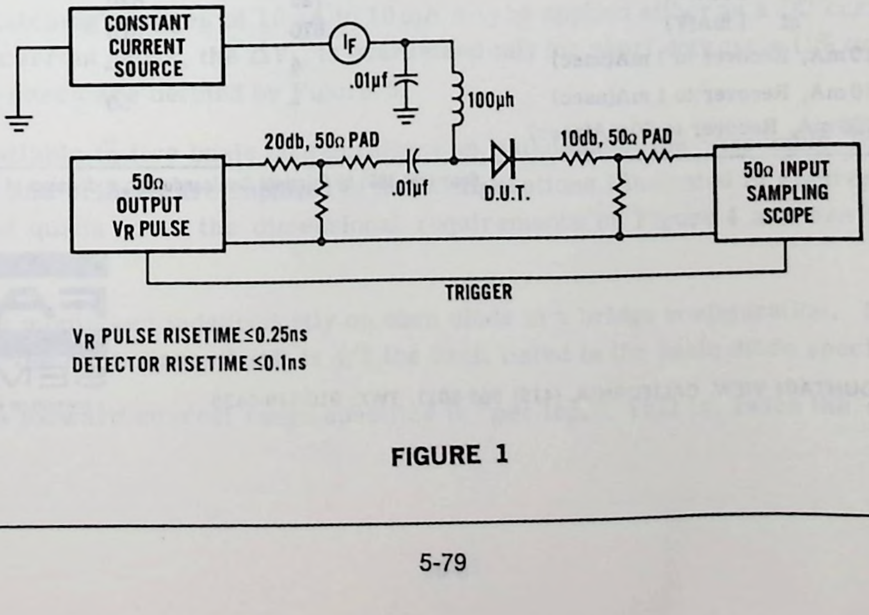

REVERSE VOLTAGE VERSUS REVERSE CURRENT


CAPACITANCE VERSUS REVERSE VOLTAGE

POST IRRADIATION


FORWARD VOLTAGE VERSUS FAST NEUTRON DOSAGE


REVERSE CURRENT VERSUS FAST NEUTRON DOSAGE


CONSTANT CURRENT SOURCE
I_F
.01μf
100μh
20db, 50Ω PAD
.01μf
D.U.T.
10db, 50Ω PAD
50Ω OUTPUT V_R PULSE
50Ω INPUT SAMPLING SCOPE
TRIGGER

V_R PULSE RISETIME ≤0.25ns
DETECTOR RISETIME ≤0.1ns

FIGURE 1

FAIRCHILD DIODE ASSEMBLIES

GENERAL DESCRIPTION - Customers' requirements and inquiries constitute the basis for the types of assemblies offered "off-the-shelf" items, and influence our efforts to obtain and publish technical information. For this reason, we encourage reque for assemblies not currently offered as standard items or requests for additional information.

The specifications contained on the succeeding pages are a condensed revision of the most popular circuit configurations us Custom assemblies tailored to individual circuit requirements are available on request.

Normal delivery is two to four weeks for types listed in this brochure. For custom assemblies, an additional one to two we is required.

SECTION 1 - EPOXY ENCAPSULATED MATCHED DIODE ASSEMBLIES

BASIC DIODE SPECIFICATIONS

MAXIMUM RATINGS (25°C)

		FD1389	FD2389	FD3389	FD6389
V_R	Reverse Voltage	75 V	150 V	125 V	50 V
I_O	Average Rectified Current	75 mA	100 mA	150 mA	200 mA
I_F	Forward Current, DC	115 mA	150 mA	225 mA	300 mA
i_f	Recurrent Peak Forward Current	225 mA	300 mA	450 mA	600 mA
i_f(surge)	1 second pulse width	.5 A	1 A	1 A	1 A
i_f(surge)	1 microsecond pulse width	2 A	4 A	4 A	4 A
P	Power Dissipation	250 mW	500 mW	500 mW	500 mW
T_A	Operating Temperature	— — — — -65°C to +175°C — — — —			
T_{stg}	Storage Temperature, Ambient	— — — — -65°C to +200°C — — — —			

ELECTRICAL SPECIFICATIONS (25°C unless noted)

BV(min)	Breakdown Voltage at 5 μA(V)	100	–	–	–
	at 100 μA(V)	–	200	150	75
I_R(max)	Reverse Leakage at V_R(nA)	100	100	1	100
	at V_R, 150°C(μA)	100	100	3	100
C(max)	Capacitance at OV(pf)	1.5	5	6	3
V_F(max)	Forward Voltage at 200 mA(V)	–	1.0	1.0	1.0
	at 100 mA(V)	–	.925	.930	.920
	at 50 mA(V)	–	.860	.880	.860
	at 20 mA(V)	1.0	.790	.840	.790
	at 10 mA(V)	.875	.740	.810	.750
	at 5 mA(V)	.800	.700	.770	.710
	at 2 mA(V)	.725	.620	.730	.670
	at 1 mA(V)	.670	.610	.710	.630
t_{rr}(max)	$I_F = I_R$ = 10 mA, Recover to 1 mA(nsec)	4	–	–	4
t_{rr}(max)	$I_F = I_R$ = 30 mA, Recover to 1 mA(nsec)	–	50	–	-
t_{rr}(max)	$I_F = I_R$ = 200 mA, Recover to 20 mA(nsec)	–	–	–	4

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SECTION 1 - EPOXY ENCAPSULATED MATCHED DIODE ASSEMBLIES

(MATCHING SPECIFICATIONS APPLY OVER TEMPERATURE RANGE OF –55°C TO +100°C)

FORWARD VOLTAGE MATCHED ASSEMBLIES

Basic Diode Specification	Forward Current Matching Range	Maximum Voltage Difference (ΔV_F) Between Diodes	Assembly Type Number Encapsulated Pair	Unencapsulated Pair	Encapsulated Quad	Unencapsulated Quad	Bridge
FD1389	10 μA to 1.0 mA	3.0 mV	FA2310E	FA2310U	FA4310E	FA4310U	FA3310
FD1389	10 μA to 1.0 mA	10 mV	FA2311E	FA2311U	FA4311E	FA4311U	FA3311
FD1389	1.0 mA to 10 mA	5 mV	FA2312E	FA2312U	FA4312E	FA4312U	FA3312
FD1389	1.0 mA to 10 mA	15 mV	FA2313E	FA2313U	FA4313E	FA4313U	FA3313
FD2389	10 μA to 1.0 mA	3.0 mV	FA2320E	FA2320U	FA4320E	FA4320U	FA3320
FD2389	10 μA to 1.0 mA	10 mV	FA2321E	FA4321U	FA4321E	FA4321U	FA3321
FD2389	1.0 mA to 10 mA	5 mV	FA2322E	FA2322U	FA4322E	FA4322U	FA3322
FD2389	1.0 mA to 10 mA	15 mV	FA2323E	FA2323U	FA4323E	FA4323U	FA3323
FD2389	10 mA to 100 mA (pulse only)	10 mV	FA2324E	FA2324U	FA4324E	FA4324U	FA3324
FD2389	10 mA to 100 mA (pulse only)	20 mV	FA2325E	FA2325U	FA4325E	FA4325U	FA3325
FD6389	10 mA to 100 mA (pulse only)	10 mV	FA2360E	FA2360U	FA4360E	FA4360U	FA3360
FD6389	10 mA to 100 mA (pulse only)	20 mV	FA2361E	FA2361U	FA4361E	FA4361U	FA3361

REVERSE CURRENT — FORWARD VOLTAGE MATCHED ASSEMBLIES

(BASIC DIODE SPECIFICATIONS: FD3389)

Maximum Reverse Current Difference (ΔI_R) Between Diodes	Forward Current Matching Range	Maximum Forward Voltage Difference (ΔV_F) Between Diodes	Encapsulated Pair	Unencapsulated Pair	Encapsulated Quad	Unencapsulated Quad	Bridge
$2.0\ nA + 0.064 \cdot V_R$	10 μA to 1.0 mA	10 mV	FA2330E	FA2330U	FA4330E	FA4330U	FA3330
$2.0\ nA + 0.064 \cdot V_R$	1.0 mA to 10 mA	15 mV	FA2331E	FA2331U	FA4331E	FA4331U	FA3331
$2.0\ nA + 0.064 \cdot V_R$	10 mA to 100 mA (pulse only)	20 mV	FA2332E	FA2332U	FA4332E	FA4332U	FA3332
$4.0\ nA + 0.128 \cdot V_R$	10 μA to 1.0 mA	10 mV	FA2333E	FA2333U	FA4333E	FA4333U	FA3333
$4.0\ nA + 0.128 \cdot V_R$	1.0 mA to 10 mA	15 mV	FA2334E	FA2334U	FA4334E	FA4334U	FA3334
$4.0\ nA + 0.128 \cdot V_R$	10 mA to 100 mA (pulse only)	20 mV	FA2335E	FA2335U	FA4335E	FA4335U	FA3335

NOTES:

The "Basic Diode Specification" column refers to the specifications listed in the table on the preceding page. These specifications are guaranteed for each individual diode of the assembly.

The "Maximum Reverse Current Difference (ΔI_R) Between Diodes" means that the difference in reverse current between the diode having the highest I_R and the diode having the lowest I_R in an assembly will not exceed the specified limit. "V_R" is the reverse voltage bias in volts at which the test is performed and may be any value between 0 and 125 V as the user desires. As an example, the specification limit for an FA2330E at a reverse bias of 10 V would be $2.0\ nA + 0.064 \cdot 10 = 2.6\ nA$. See Figure 6 for ΔI_R test circuit.

The "Forward Current Matching" ranges of 10 μA to 10 mA may be applied either as a DC current or pulse input current. For the 10 mA to 100 mA current range, the ΔV_F is guaranteed only for short duty cycle (1% or less) input current pulses. Conditions of test in both cases are defined by Figure 5.

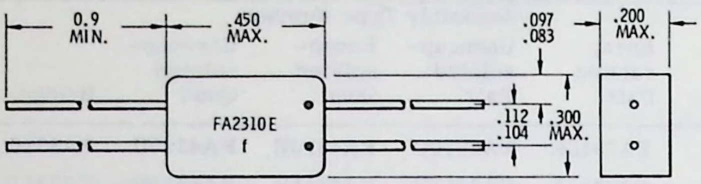
All specifications are available in five basic configurations as listed under the "Assembly Type Number" column. Encapsulated pairs, quads, and bridges are supplied in the configurations illustrated in Figures 1, 2, and 3 respectively. Unencapsulated pairs and quads meet the dimensional requirements of Figure 4 and are taped securely together for shipment.

Capacitance (C) cannot be monitored independently on each diode in a bridge configuration. In measuring this parameter on bridge configurations, the capacitance limit is 4/3 the limit listed in the basic diode specifications table.

For matched bridges, the forward current range specified is "per leg." That is, twice the current specified is applied to the assembly.

SECTION 1 - EPOXY ENCAPSULATED MATCHED DIODE ASSEMBLIES

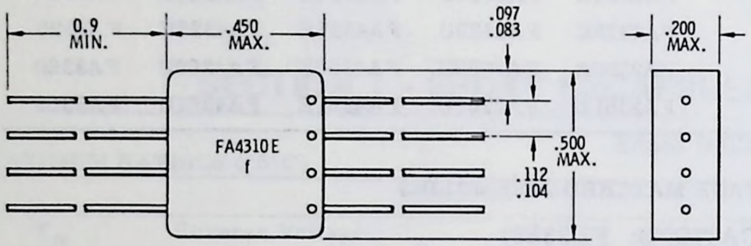
FIG. 1 ENCAPSULATED MATCHED PAIR PACKAGE DIMENSIONS.


0.9
MIN.
.450
MAX.
.097
.083
.200
MAX.
FA2310E
f
.112
.104
.300
MAX.

NOTES:

1. Dots denote cathode ends of diodes.
2. All dimensions in inches.

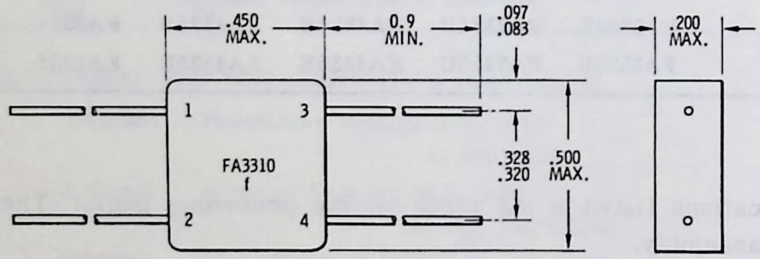
FIG. 2 ENCAPSULATED MATCHED QUAD PACKAGE DIMENSIONS.


0.9
MIN.
.450
MAX.
.097
.083
.200
MAX.
FA4310E
f
.500
MAX.
.112
.104

NOTES:

1. Dots denote cathode ends of diodes.
2. All dimensions in inches.

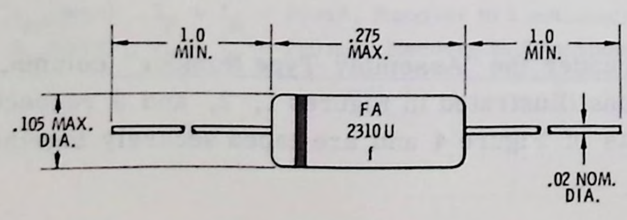
FIG. 3 BRIDGE PACKAGE DIMENSIONS.


.450
MAX.
0.9
MIN.
.097
.083
.200
MAX.
1
3
2
4
FA3310
f
.328
.320
.500
MAX.

NOTES:

1. Numbers 1 and 2 denote the common anode and common cathode terminals of the bridge, respectively. Terminals 3 and 4 denote the two cathode-anode terminals.
2. All dimensions in inches.

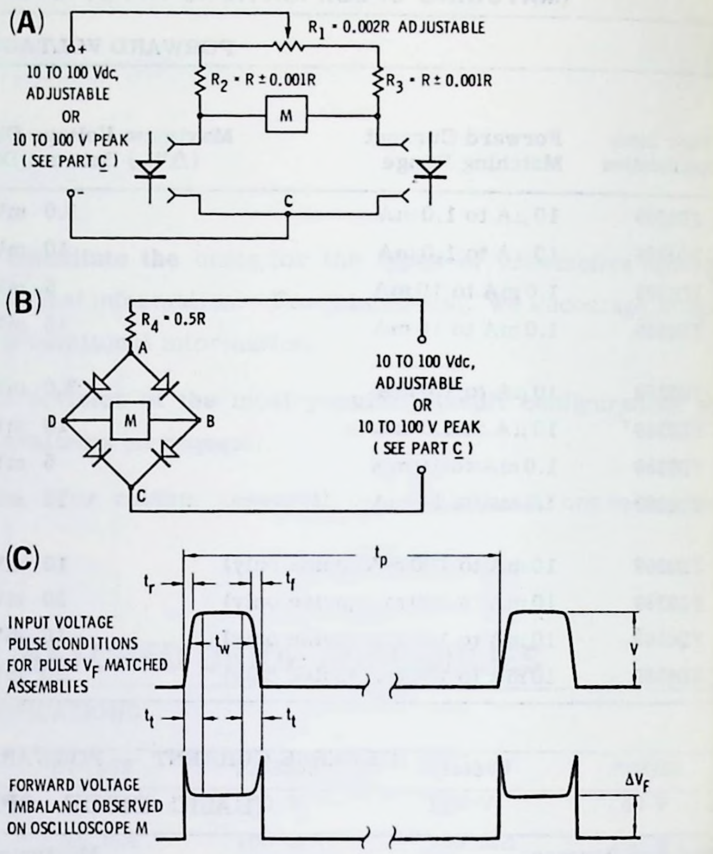
FIG. 4 INDIVIDUAL DIODE DIMENSIONS FOR UNENCAPSULATED MATCHED PAIRS AND QUADS.


1.0
MIN.
.275
MAX.
1.0
MIN.
.105 MAX.
DIA.
FA
2310 U
f
.02 NOM.
DIA.

NOTES:

1. Band denotes cathode end of diode.
2. All dimensions in inches.

FIG. 5 ΔV_F DIODE MATCHING CIRCUITS.


(A)
R1 = 0.002R ADJUSTABLE
+
10 TO 100 Vdc,
ADJUSTABLE
OR
10 TO 100 V PEAK
(SEE PART C)
-
R2 = R ± 0.001R
R3 = R ± 0.001R
M
C
(B)
R4 = 0.5R
A
D
M
B
C
10 TO 100 Vdc,
ADJUSTABLE
OR
10 TO 100 V PEAK
(SEE PART C)
(C)
tp
tr
tf
INPUT VOLTAGE
PULSE CONDITIONS
FOR PULSE VF MATCHED
ASSEMBLIES
tw
V
tt
tt
FORWARD VOLTAGE
IMBALANCE OBSERVED
ON OSCILLOSCOPE M
ΔVF

t_r Pulse Rise Time (10 to 90% Amplitude) = 1μsec Max.
t_f Pulse Fall Time (90 to 10% Amplitude) = 1μsec Max.
t_w Pulse Width (50% Amplitude) = 10 ± 2 μsec
t_t Transient Time = 1 μsec Min.
t_p Period = 1 msec
V Voltage Input to Circuit "A or B" = 10 to 1 Adjustable
ΔV_f Forward Voltage Difference Between Diodes (Measured Between Transient Times) = As Speci

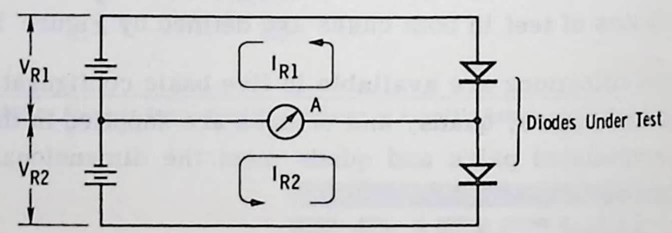
NOTES:

1. R varies depending on the current range. For the most often used current ranges, R is as follows:

Current Range (amperes)	R (ohms)
10^{-5} to 10^{-4}	10^6
10^{-4} to 10^{-3}	10^5
10^{-3} to 10^{-2}	10^4
or 10^{-n} to 10^{-n+1}	10^{n+1}

2. The input voltage pulse conditions illustrated in part C are employed at Fairchild in testing. The user may deviate from the specific conditions above with no variation in results providing the following general conditions are met:
   a. $\frac{tw}{tp} < 0.01$
   b. tw <10 milliseconds
   c. Transients occuring during pulse rise and fall times are ignored in observing ΔV_F.

FIG. 6 ΔI_R DIODE MATCHING CIRCUIT


VR1
VR2
IR1
IR2
A
Diodes Under Test

NOTES:

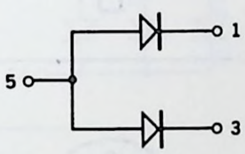
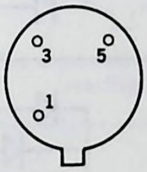
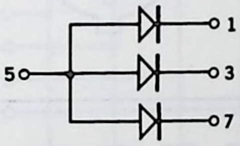
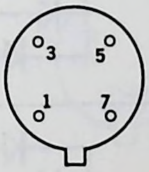
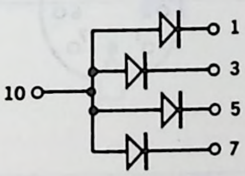
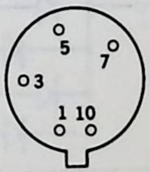
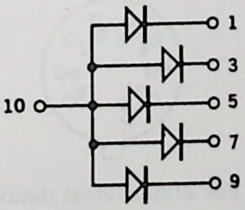
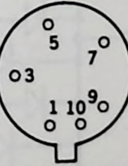
1. $V_{R2} = -V_{R1} \pm 1\%$.
2. $I_{R2} - I_{R1} = \Delta I_R$ (difference in I_R between two diodes under test).
3. A is a center reading $\mu\mu$ ammeter.

BASIC DIODE SPECIFICATIONS

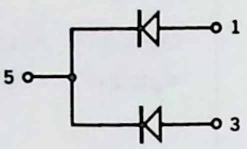
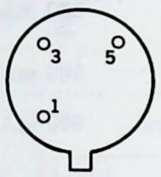
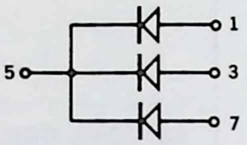
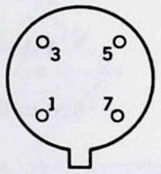
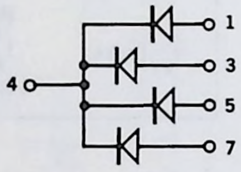
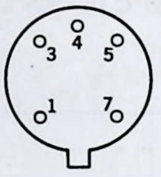
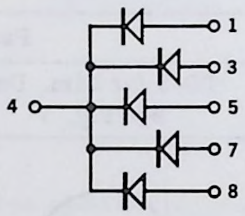
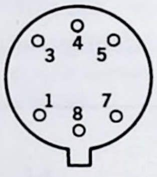
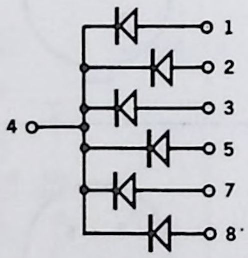
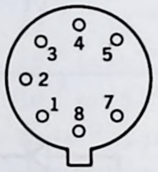
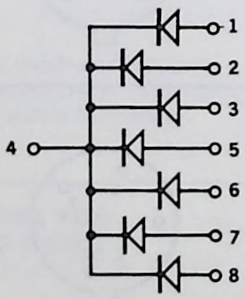
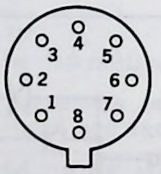
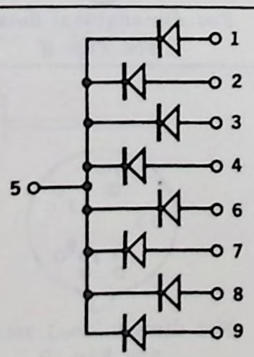
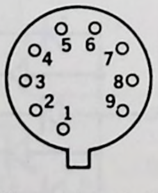
MAXIMUM RATINGS (25°C)		
WV_R	Reverse Voltage	50 V
I_O	Average Rectified Current	200 mA
I_F	Forward Current, DC	300 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	1 second pulse width	1 A
i_f(surge)	1 microsecond pulse width	4 A
P	Power Dissipation	500 mW
T_A	Operating Temperature	-65°C to +175°C
T_{stg}	Storage Temperature, Ambient	-65°C to +200°C

ELECTRICAL SPECIFICATION (25°C unless noted)		
BV(min)	Breakdown Voltage @ 100 μA(V)	75
I_R(max)	Reverse Leakage @ V_R(nA)	100
	@ V_R, 150°C(μA)	100
C(max)	Capacitance @ OV(pf)	3
V_F(max)	Forward Voltage @ 200 mA(V)	1.0
	@ 100 mA(V)	.920
	@ 50 mA(V)	.860
	@ 20 mA(V)	.790
	@ 10 mA(V)	.750
	@ 5 mA(V)	.710
	@ 2 mA(V)	.670
	@ 1 mA(V)	.630
t_{rr}(max)	$I_F = I_R = 10$ mA, Recover to 1 mA (nsec)	4
t_{rr}(max)	$I_F = I_R = 200$ mA, Recover to 20 mA (nsec)	4

COMMON ANODE ASSEMBLIES

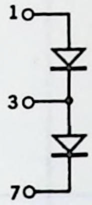
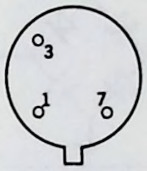
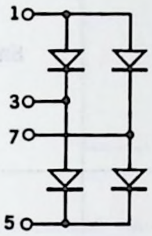
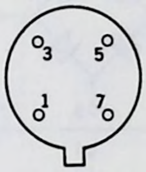
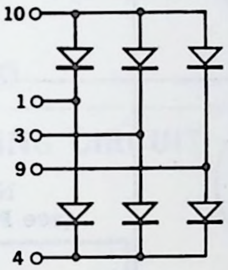
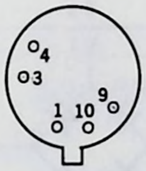
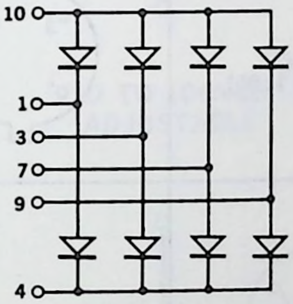
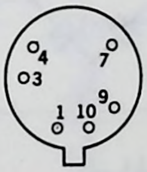
Type Number		Circuit Configuration	Package Configuration	
TO-5	TO-18		TO-5 for Dim. Det. see Fig. 7	TO-18 for Dim. Det. see Fig. 8
FSA 1177	FSA 1178			Same as TO-5
FSA 1179	FSA 1181			Same as TO-5
FSA 1182	----		 For dimensional details see Fig. 9	NONE
FSA 1183	----		 For dimensional details see Fig. 9	NONE

COMMON CATHODE ASSEMBLIES

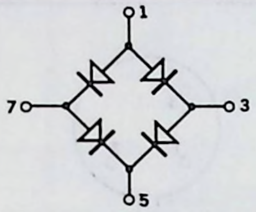
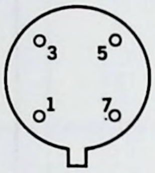
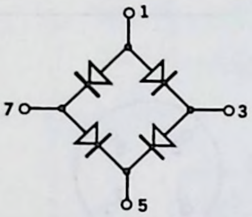
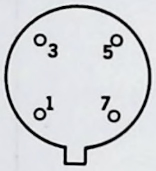
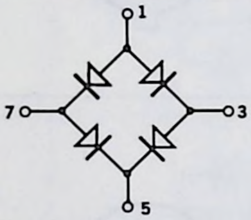
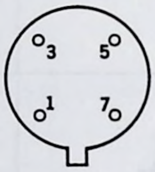
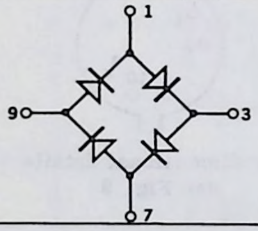
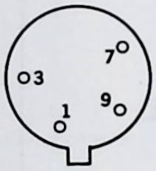
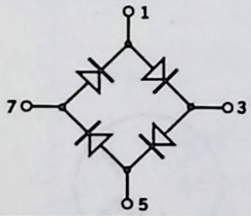
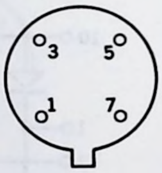
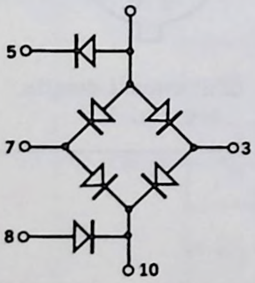
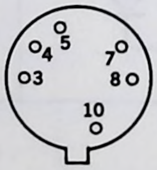
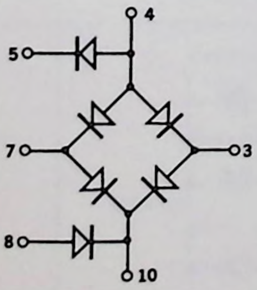
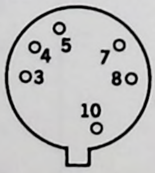
Type Number		Circuit Configuration	Package Configuration	
TO-5	TO-18		TO-5 for Dim. Det. see Fig. 7	TO-18 for Dim. Det. see Fig. 8
FSA 1169	FSA 1202			Same as TO-5
FSA 1171	FSA 1172			Same as TO-5
FSA 1203	FSA 1173			Same as TO-5
FSA 1174	----			NONE
FSA 1204	----			NONE
FSA 1175	----			NONE
FSA 1176	----		 For dimensional details see Fig. 9	NONE

NOTE: Transistor outline assemblies are available using other basic diode types (i.e., FD100, FD200, etc.) on reque

MATRIX ASSEMBLIES

Type Number		Circuit Configuration	Package Configuration	
TO-5	TO-18		TO-5 for Dim. Det. see Fig. 7	TO-18 for Dim. Det. see Fig. 8
FSA 1184	FSA 1185			Same as TO-5
FSA 1186	FSA 1187			Same as TO-5
FSA 1188	----		 For dimensional details see Fig. 9	NONE
FSA 1189	----		 For dimensional details see Fig. 9	NONE

BRIDGES AND TRANSMISSION GATES

Type Number		Circuit Configuration	Package Configuration		Matching Specifications* T_A =-55°C to 100°C (for Test Circuits, see Figs. 10 and 11)
TO-5	TO-18		TO-5 for Dim. Det. see Fig. 7	TO-18 for Dim. Det. see Fig. 8	
FSA 1197	**FSA 1198**			Same as TO-5	NONE
FSA 1191	**FSA 1192**			Same as TO-5	$\Delta V_F < 5.0$ mV I_F = 20 μA to 20 mA
FSA 1193	**FSA 1194**			Same as TO-5	$\Delta V_F < 5.0$ mV I_F = 20 μA to 20 mA $\Delta I_R < 1.0\,\mu$A V_R = 25 V
FSA 1195	----		 **	NONE (see FSA 1196)	$\Delta V_F < 5.0$ mV I_F = 10 μA to 10 mA
----	**FSA 1196**		NONE (see FSA 1195)		$\Delta V_F < 5.0$ mV I_F = 10 μA to 10 mA
FSA 1199	----		 **	NONE	$\Delta V_F < 5.0$ mV I_F = 20 μA to 20 mA
FSA 1201	----		 **	NONE	$\Delta V_F < 5.0$ mV I_F = 20 μA to 20 mA $\Delta I_R < 1.0\,\mu$A V_R = 25 V

* I_F specified is total bridge current and is applied between common-cathode and common-anode terminals except for FSA 1 and FSA 1196. For these two types, I_F specified is "per diode."

** For Dimensional Details see Fig. 10.

FIGURE 7*

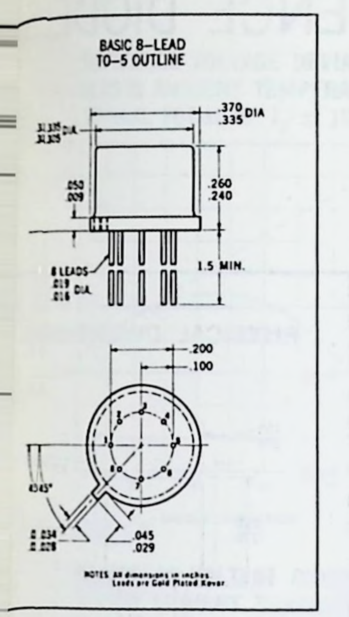

BASIC 8–LEAD TO–5 OUTLINE
.370 .335 DIA
.050 .009
.260 .240
8 LEADS .019 .016 DIA.
1.5 MIN.
.200 .100
45°
.034 .028
.045 .029
NOTES All dimensions in inches. Leads are Gold Plated Kovar

FIGURE 8*

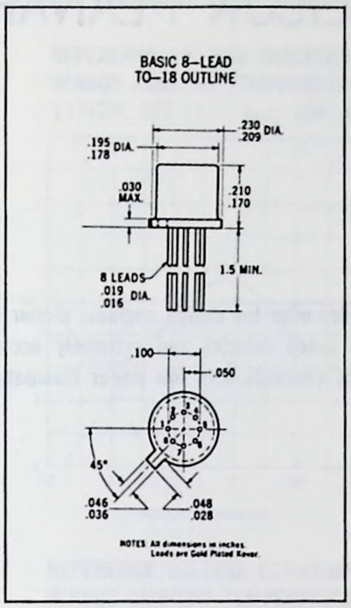
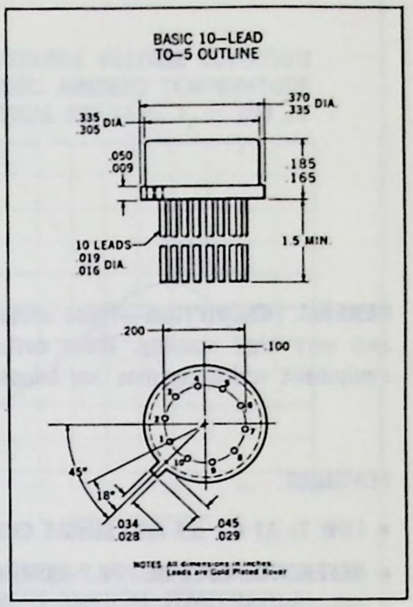

BASIC 8–LEAD TO–18 OUTLINE
.230 .209 DIA.
.195 .178 DIA.
.030 MAX.
.210 .170
8 LEADS .019 .016 DIA.
1.5 MIN.
.100
.050
45°
.046 .036
.048 .028
NOTES All dimensions in inches. Leads are Gold Plated Kovar.

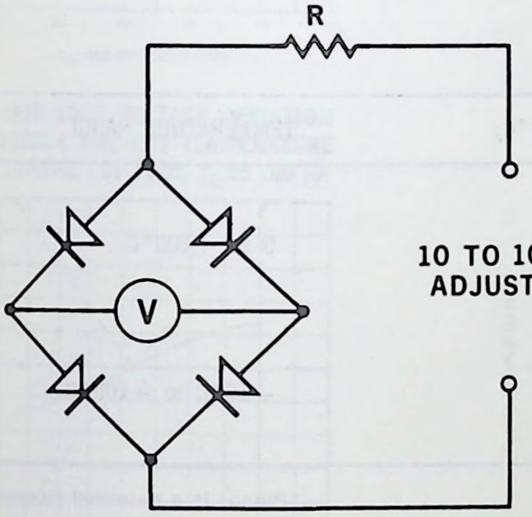
FIGURE 9*


BASIC 10–LEAD TO–5 OUTLINE
.370 .335 DIA.
.335 .305 DIA.
.050 .009
.185 .165
10 LEADS .019 .016 DIA.
1.5 MIN.
.200
.100
45°
18°
.034 .028
.045 .029
NOTES All dimensions in inches. Leads are Gold Plated Kovar

Figures 7, 8, and 9 provide package dimensions and lead position information for all assemblies. For ease in reference, all ossible lead break-outs are illustrated. For a given type, only those leads specified in the "Package Configuration" column f the preceding tables actually appear on the assembly.

FIGURE 10

ΔV_F BRIDGE MATCHING CIRCUIT


R
V
10 TO 100Vdc ADJUSTABLE

NOTES:

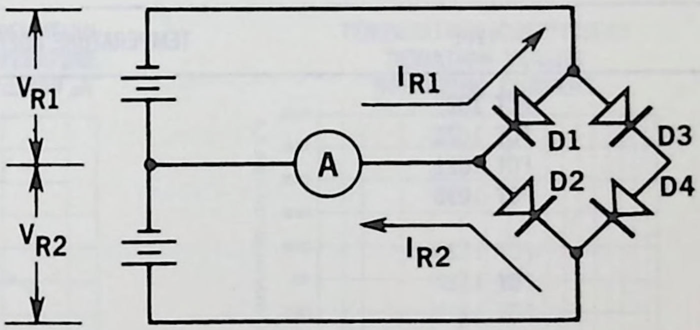
1. R Varies depending on the current range. For the most often used current ranges, R is as follows:

Current Range (amperes)	R (ohms)
10^{-5} to 10^{-4}	10^6
10^{-4} to 10^{-3}	10^5
10^{-3} to 10^{-2}	10^4
or 10^{-n} to 10^{-n+1}	10^{n+1}

2. V indicates mismatch of assembly.

FIGURE 11

ΔI_R BRIDGE MATCHING CIRCUIT


V_{R1}
V_{R2}
A
I_{R1}
I_{R2}
D1
D2
D3
D4

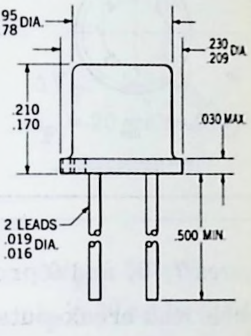
NOTES:

1. $V_{R2} = -V_{R1}$ ±1%.
2. $I_{R2} - I_{R1} = \Delta I_R$ (difference in I_R between diodes D1 & D2). To measure diodes D3 & D4, reverse cathode-anode terminal connections.
3. A is a center reading $\mu\mu$ ammeter. ΔI_R indicated directly on A.

FCT Series
SILICON PLANAR* REFERENCE DIODES

GENERAL DESCRIPTION—These unique low power reference diodes offer the design engineer planar reliability and very high stability. These devices are ideally suited for space vehicles and extremely accurate test equipment which requires low temperature coefficient reference elements with low power dissipation.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

FEATURES:

- **LOW Tc AT 0.1 mA AND SINGLE CHIP CONSTRUCTION**
- **REFERENCE VOLTAGE - - 6.7 NOMINAL**
- **VOLTAGE TOLERANCE - - ±5.0%** (Note 1)
- **REVERSE LEAKAGE 100 NANO-AMPS AT 5.0 V**
- **DYNAMIC IMPEDANCE - - 750 Ω MAXIMUM @ 100 μA**
- **MAXIMUM OPERATING JUNCTION TEMPERATURE - - 175°C**

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

TYPE	TEMPERATURE COEFFICIENT @ 100 μA (%/°C)	TEMPERATURE RANGE
FCT 1025	± .005	0 to +100°C
FCT 1022	± .002	
FCT 1021	± .001	
FCT 1035	± .0005	
FCT 1125	± .005	−55°C to +100°C
FCT 1122	± .002	
FCT 1121	± .001	
FCT 1135	± .0005	

*Planar is a patented Fairchild proce

NOTES:

(1) Voltage tolerances tighter than ±5% are available upon request.

(2) Temperature coefficient is determined by measuring VZ at the two temperature extremes and using the following formula:

$$TC = \frac{(V_{T1} - V_{T2})\,100}{V(_{T1} - _{T2})} \quad \text{where } V = \frac{V_{T1} + V_{T2}}{2}$$

(3) Devices are mounted in two-leaded TO-18 package and with a black dot opposite cathode lead on side of case.

(4) All devices receive the following 100% processing: (a) HTOPL: 96 hrs, +125°C, 100 μA
(b) HTS: 48 hrs, +200°C

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SEMICONDUCTOR
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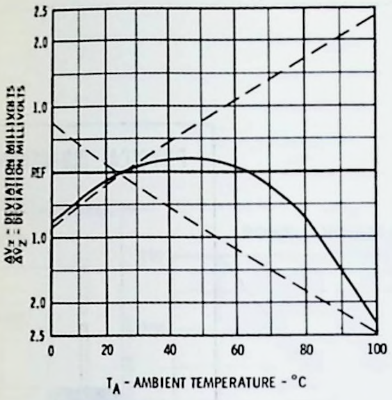
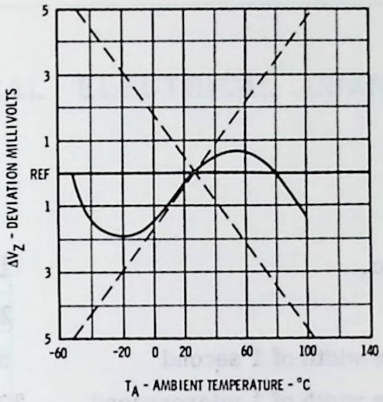
TYPICAL ELECTRICAL CHARACTERISTICS

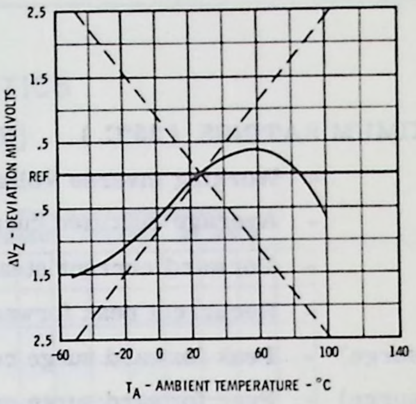
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1035, $I_Z = 100\ \mu A$



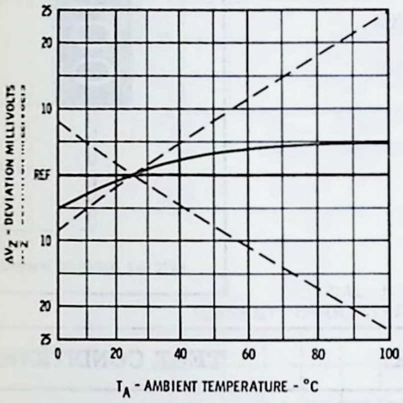
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1121, $I_Z = 100\ \mu A$



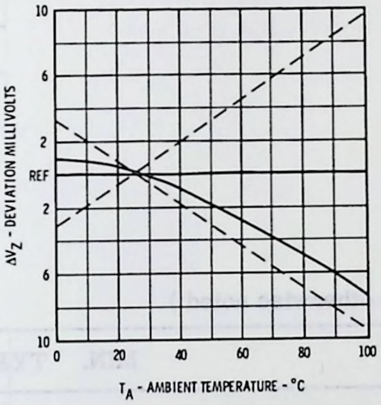
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1135, $I_Z = 100\ \mu A$



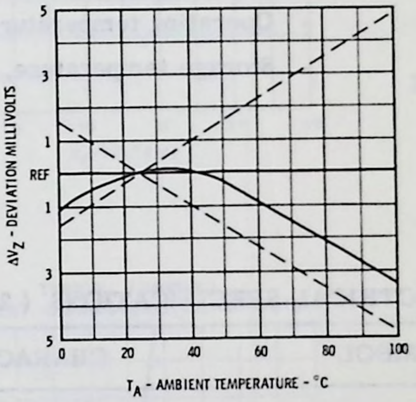
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1025, $I_Z = 100\ \mu A$



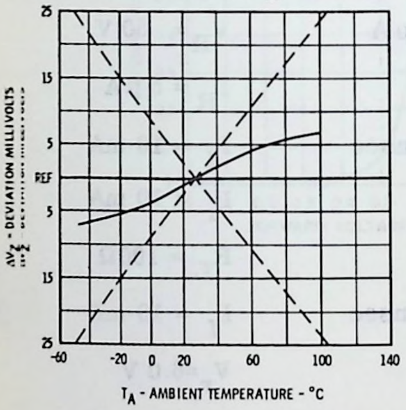
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1022, $I_Z = 100\ \mu A$



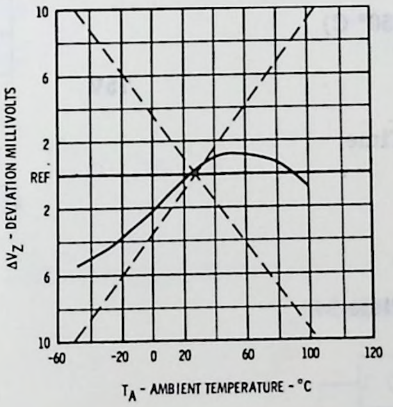
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1021, $I_Z = 100\ \mu A$



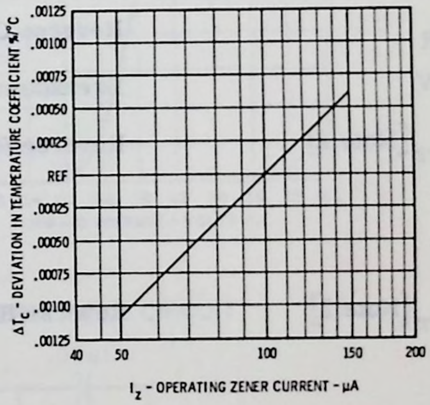
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1125, $I_Z = 100\ \mu A$



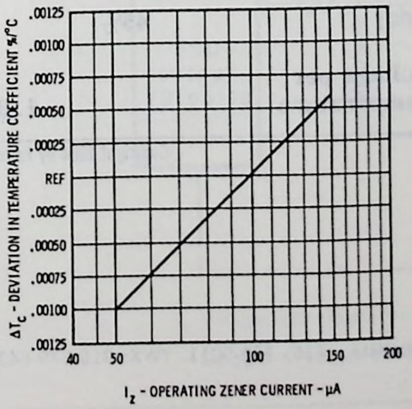
REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1122, $I_Z = 100\ \mu A$



TEMPERATURE COEFFICIENT DEVIATION VERSUS OPERATING CURRENT



TEMPERATURE COEFFICIENT DEVIATION VERSUS OPERATING CURRENT

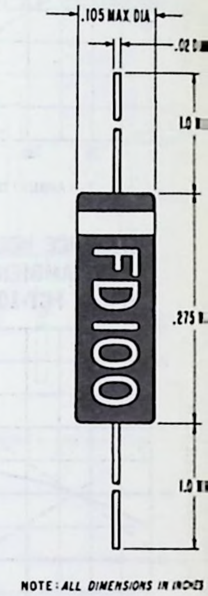


FD100
ULTRA-FAST PLANAR DIODE

MAXIMUM RATINGS (25°C.) [Note 1]

WIV	-	Working Inverse Voltage	50 V
I_o	-	Average rectified current	75 mA
I_F	-	Forward current steady state d. c.	115 mA
i_f	-	Recurrent peak forward current	225 mA
i_f (surge)	-	Peak forward surge current pulse width of 1 second	500 mA
i_f (surge)	-	Peak forward surge current pulse width of 1 microsecond	2000 mA
P	-	Power dissipation	250 mW
$\frac{1}{\theta}$	-	Power derating factor	1.67 mW/°C
T_A	-	Operating temperature	-65° to + 175°C
T_{stg}	-	Storage temperature, ambient	-65° to + 200°C

PHYSICAL DIMENSION



NOTE: ALL DIMENSIONS IN INCHES

ELECTRICAL SPECIFICATIONS (25° C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYPICAL	MAX.	TEST CONDITIONS
V_F	Forward Voltage			1.0 V	I_F = 10 mA
I_R	Reverse Current			0.1 μA	V_R = 50 V
I_R	Reverse Current (150° C)			100 μA	V_R = 50 V
BV	Breakdown Voltage	75V			I_R = 5 μA
t_{rr} [Note 2]	Reverse Recovery Time			4.0 nsec	I_f = 10 mA I_r = 10 mA R_L = 100Ω
t_{rr} [Note 2]	Reverse Recovery Time			2.0 nsec	I_f = 10 mA V_r=6.0 V R_L = 100Ω
C_o [Note 3]	Capacitance			2.0 pf	V_R = 0 V f = 1 mc
RE	Rectification Efficiency	45%			100 mc [Note 4]
ΔV_F/°C	Change of forward voltage per degree change in temperature		-1.8mV		

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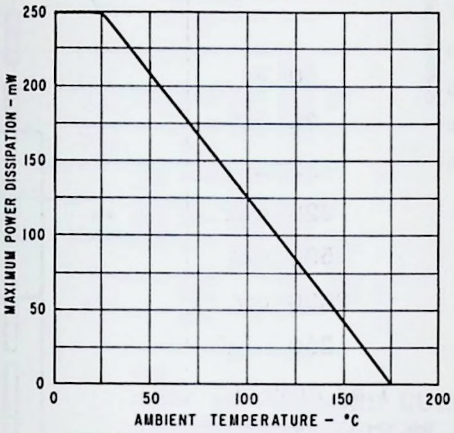
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

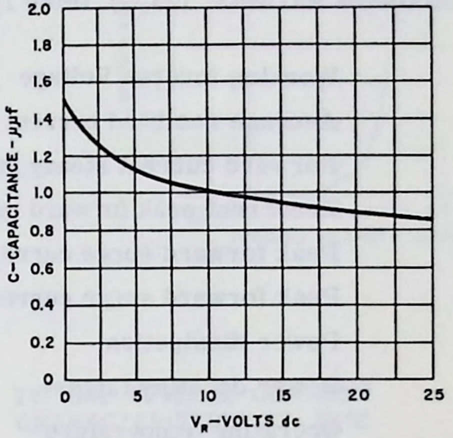
NOTES:
(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 1 mA in circuit shown on page 2 of data sheet.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
(4) Rectification efficiency is defined as the ratio of D.C. load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V r.m.s. input to the circuit. Load resistance 5 K ohms, load capacitance 20 $\mu\mu f$.

TYPICAL ELECTRICAL CHARACTERISTICS

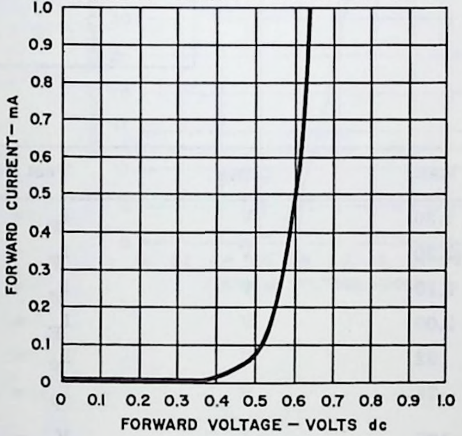
POWER DERATING CURVE



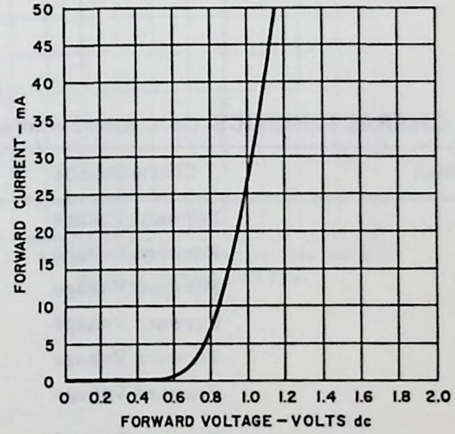
TYPICAL CAPACITANCE VERSUS VOLTAGE AT 25°C



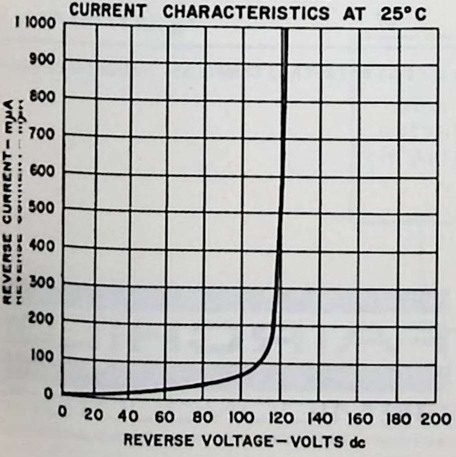
TYPICAL FORWARD CURRENT CHARACTERISTICS AT 25°C



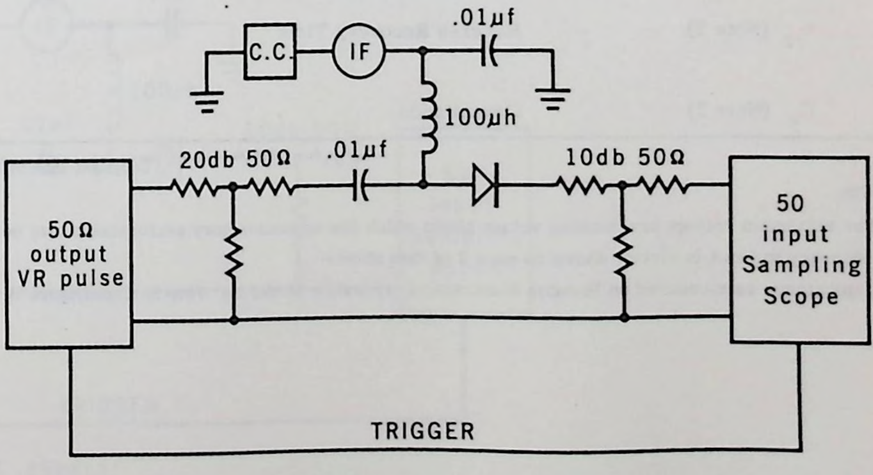
TYPICAL FORWARD CURRENT CHARACTERISTICS AT 25°C



TYPICAL REVERSE CURRENT CHARACTERISTICS AT 25°C



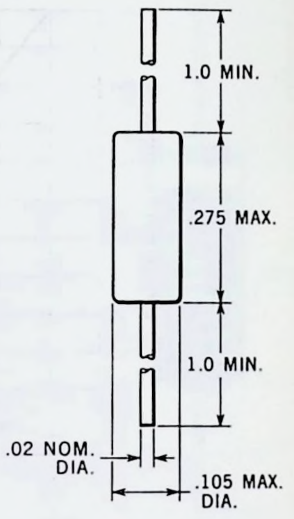
REVERSE RECOVERY TEST CIRCUIT



VR pulse risetime ≤ .25nsec
Scope risetime ≤ .35nsec

FD111
ULTRA-FAST PLANAR DIODE

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches. Weight: 0.25 gram.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	50 V
I_o	Average rectified current	75 mA
I_F	Forward current steady state DC	115 mA
i_f	Recurrent peak forward current	225 mA
i_f (surge)	Peak forward surge current pulse width of 1 second	500 mA
i_f (surge)	Peak forward surge current pulse width of 1 μsec	2000 mA
P	Power dissipation	250 mW
$\frac{1}{\theta}$	Power derating factor	1.67 mW/°C
T_A	Operating temperature	-65°C to +175°C
T_{stg}	Storage temperature, ambient	-65°C to +200°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage	.90	1.30	V	I_F = 50 mA
V_F	Forward Voltage	.87	1.20	V	I_F = 40 mA
V_F	Forward Voltage	.78	1.10	V	I_F = 20 mA
V_F	Forward Voltage	.72	1.00	V	I_F = 10 mA
V_F	Forward Voltage	.67	.92	V	I_F = 5 mA
V_F	Forward Voltage	.57	.76	V	I_F = 1 mA
I_R	Reverse Current		100	nA	V_R = -55 V
I_R	Reverse Current (100°C)		6	μA	V_R = -55 V
BV	Breakdown Voltage	75		V	I_R = 5 μA
t_{rr} (Note 2)	Reverse Recovery Time		5	nsec	$I_F = I_R$ = 10 mA R_L = 100 Ω
C_o (Note 3)	Capacitance		2.5	pf	V_R = 0 V, f = 1 mc

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NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 1 mA in circuit shown on page 2 of data sheet.

(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

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FAIRCHILD SEMICONDUCTOR
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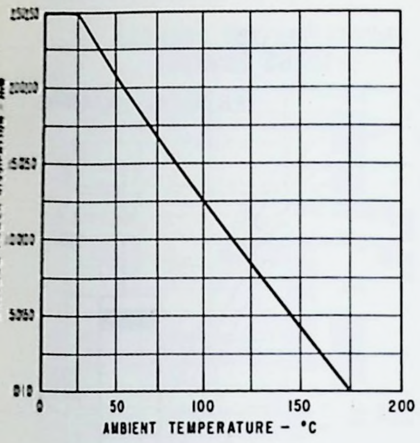
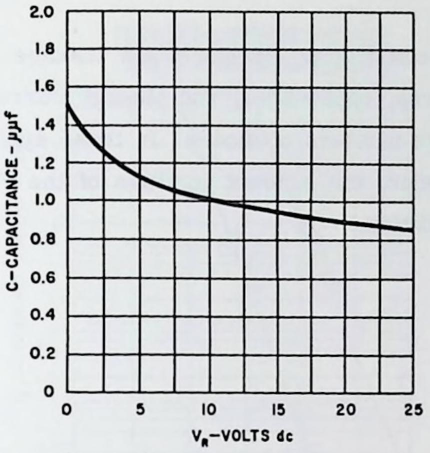
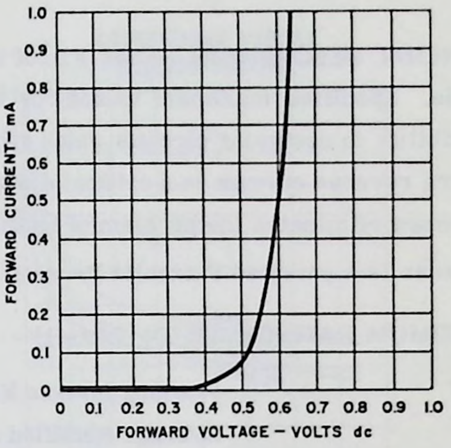
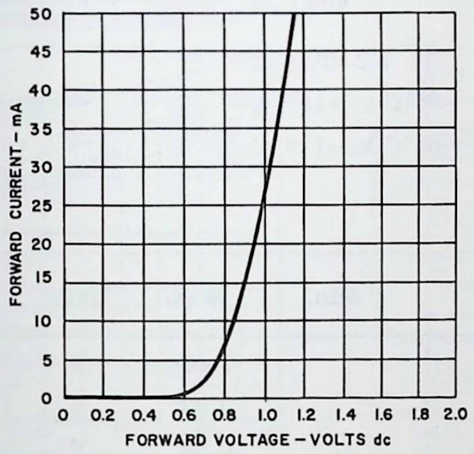
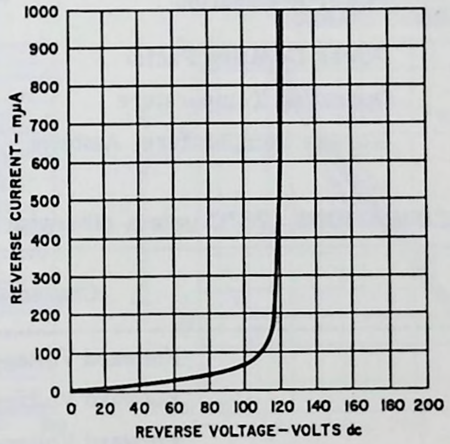
TYPICAL ELECTRICAL CHARACTERISTICS


POWER DERATING CURVE

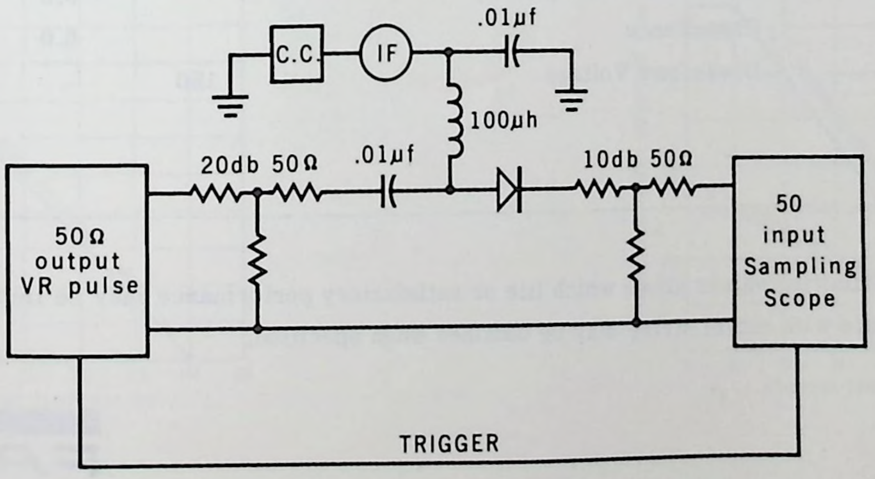

TYPICAL CAPACITANCE VERSUS VOLTAGE AT 25°C


TYPICAL FORWARD CURRENT CHARACTERISTICS AT 25°C


TYPICAL FORWARD CURRENT CHARACTERISTICS AT 25°C


TYPICAL REVERSE CURRENT CHARACTERISTICS AT 25°C

REVERSE RECOVERY TEST CIRCUIT


C.C.
IF
.01μf
100μh
20db 50Ω
.01μf
10db 50Ω
50Ω output VR pulse
50 input Sampling Scope
TRIGGER

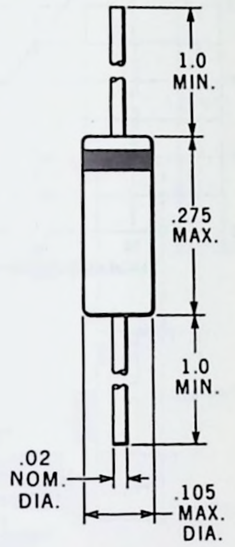
VR pulse risetime ≤ .25nsec
Scope risetime ≤ .35nsec

FD300
HIGH CONDUCTANCE LOW LEAKAGE PLANAR DIODE

GENERAL DESCRIPTION - The FD 300 is a high conductance extremely low leakage Planar* diode. Specified maximum values for voltage drop, capacitance, and leakage current mean flexibility in designing circuits which require large numbers of diodes. In those applications where reverse current is a critical design parameter, the inherent qualities of the Fairchild process eliminates the problem of leakage degradation.

*Planar is a patented Fairchild Process.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Weight: 0.25 gram.

SEE NOTE 2

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	125 V
I_o	Average Rectified Current	150 mA
I_F	Forward Current Steady State DC	375 mA
i_f	Recurrent Peak Forward Current	450 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs.	4000 mA
P	Power Dissipation	400 mW
$\frac{1}{\theta}$	Power Derating Factor	3.2 mW/°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage		1.00	V	I_F = 200 mA
V_F	Forward Voltage		0.92	V	I_F = 100 mA
V_F	Forward Voltage		0.88	V	I_F = 50 mA
V_F	Forward Voltage		0.80	V	I_F = 10 mA
V_F	Forward Voltage		0.75	V	I_F = 5 mA
V_F	Forward Voltage		0.68	V	I_F = 1 mA
I_{R1}	Reverse Current		1.0	nA	V_R = -125 V
I_{R4}	Reverse Current (150°C)		3.0	μA	V_R = -125 V
C	Capacitance		6.0	pF	V_R = 0
BV	Breakdown Voltage	150		VDC	I_R = 100 μA

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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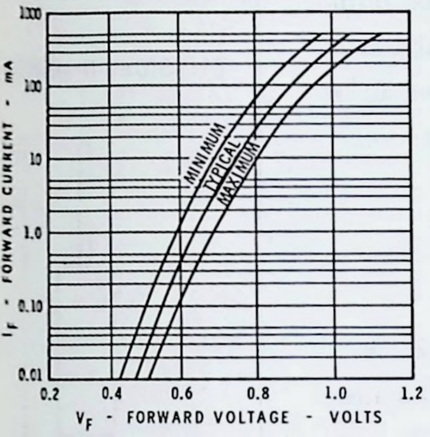
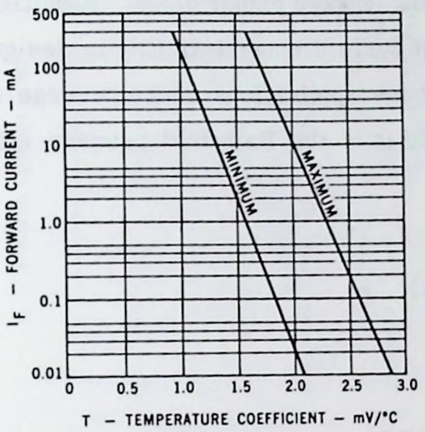
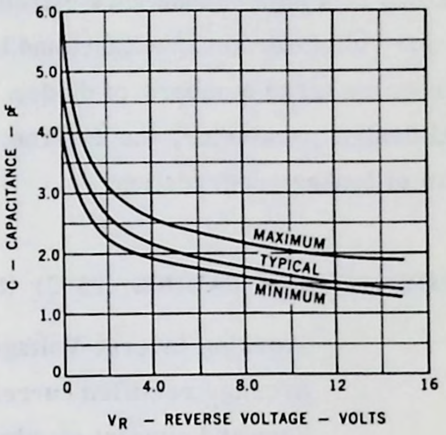
TYPICAL ELECTRICAL CHARACTERISTICS



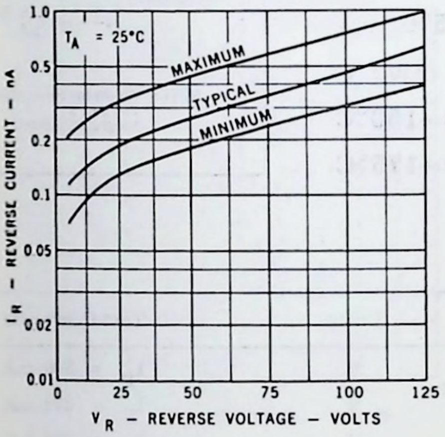
FORWARD VOLTAGE VERSUS FORWARD CURRENT



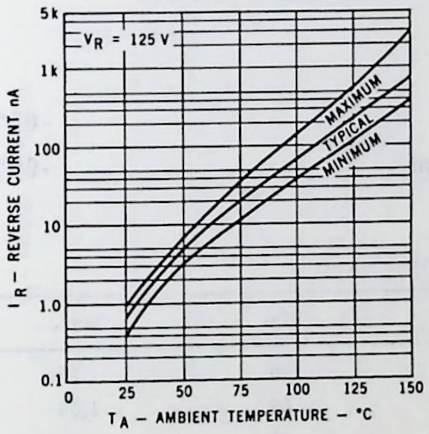
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



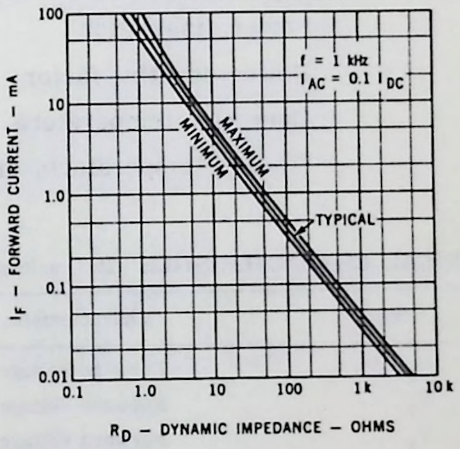
CAPACITANCE VERSUS REVERSE VOLTAGE



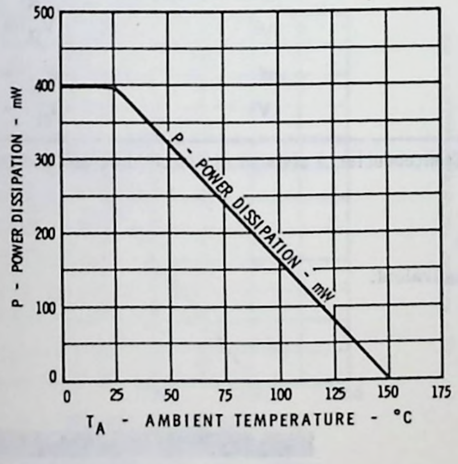
REVERSE VOLTAGE VERSUS REVERSE CURRENT



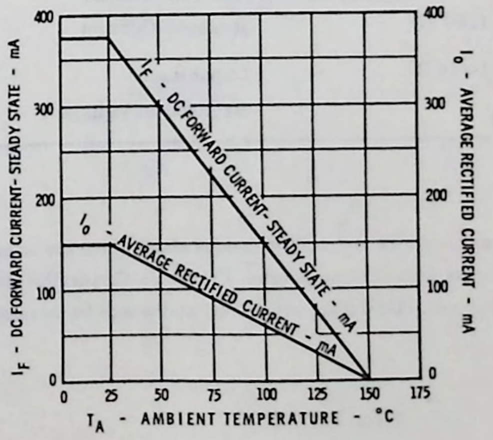
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



POWER DERATING CURVE



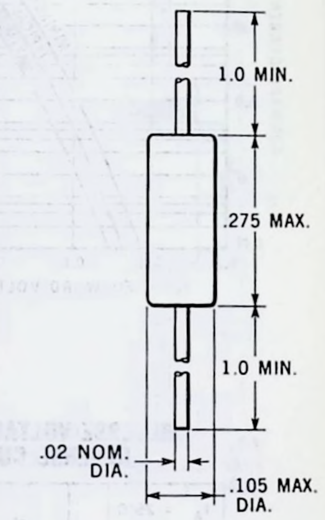
AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE

FD333

HIGH CONDUCTANCE LOW LEAKAGE PLANAR DIODE

The FD333 is a high conductance extremely low leakage planar diode. Specified maximum values for voltage drop capacitance and leakage current mean flexibility in designing circuits which require large numbers of diodes. In those applications where reverse current is a critical design parameter, the inherent qualities of the Fairchild process eliminate the problem of leakage degradation.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
See note 3.
Weight: 0.25 gram.

ABSOLUTE MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	125 V
I_o	Average rectified current	150 mA
I_F	Forward current steady state DC	225 mA
i_f	Recurrent peak forward current	450 mA
i_f (surge)	Peak forward surge current pulse width of 1 second	500 mA
i_f (surge)	Peak forward surge current pulse width of 1 μsec.	4000 mA
P	Power dissipation	500 mW
$\frac{1}{\theta}$	Power derating factor	4.0 mW/°C
T_A	Operating temperature	-65°C to +150°C
T_{stg}	Storage temperature, ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage	.90	1.15	V	I_F = 300 mA
V_F	Forward Voltage	.88	1.08	V	I_F = 250 mA
V_F	Forward Voltage	.87	1.05	V	I_F = 200 mA
V_F	Forward Voltage	.86	.97	V	I_F = 150 mA
V_F	Forward Voltage	.83	.94	V	I_F = 100 mA
V_F	Forward Voltage	.80	.89	V	I_F = 50 mA
I_R	Reverse Current		3	nA	V_R = −125 V
I_R (100°C)	Reverse Current		500	nA	V_R = −125 V
C_o (note 2)	Capacitance		10	pf	V_R = 0 V
BV	Breakdown Voltage	150		V	I_R = 5 μA

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NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.

(3) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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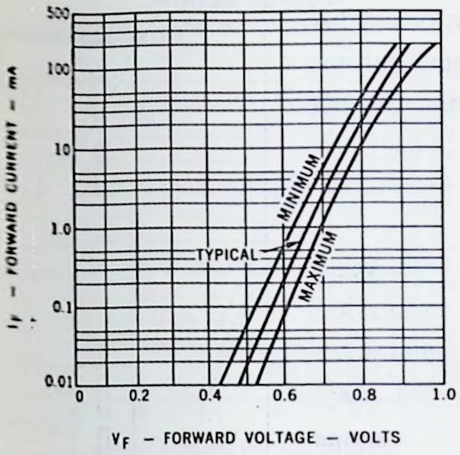
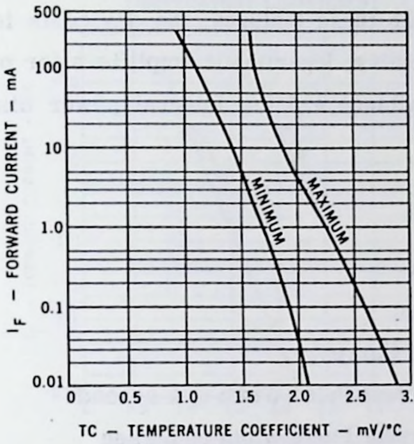
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD HIGH CONDUCTANCE LOW LEAKAGE PLANAR DIODE

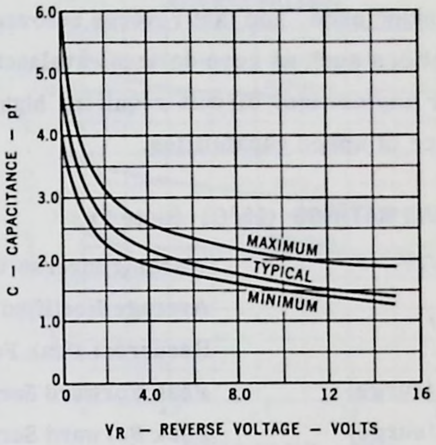
TYPICAL ELECTRICAL CHARACTERISTICS



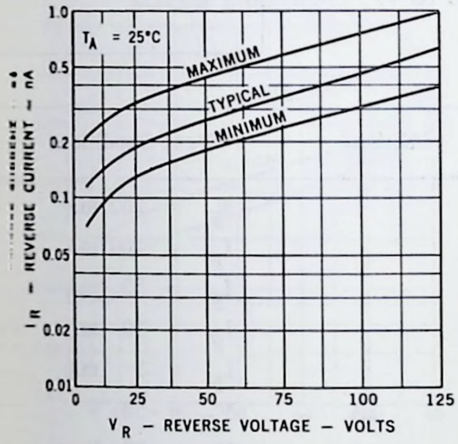
FORWARD VOLTAGE VERSUS FORWARD CURRENT



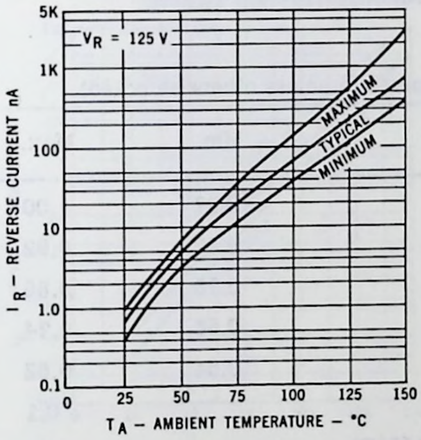
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



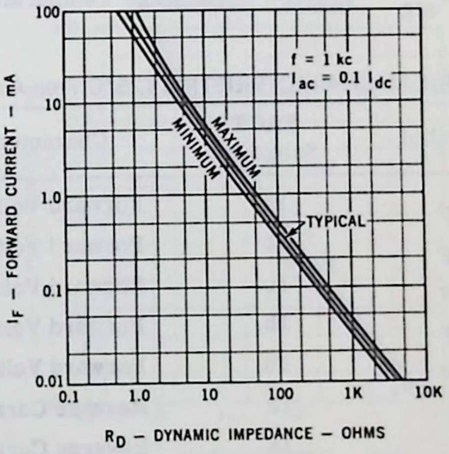
CAPACITANCE VERSUS REVERSE VOLTAGE



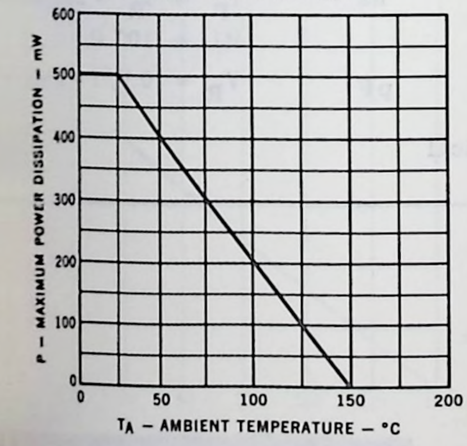
REVERSE VOLTAGE VERSUS REVERSE CURRENT



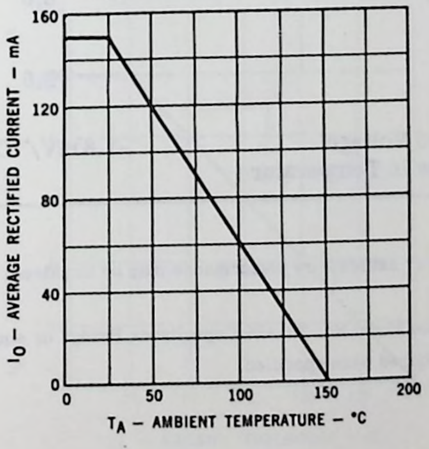
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



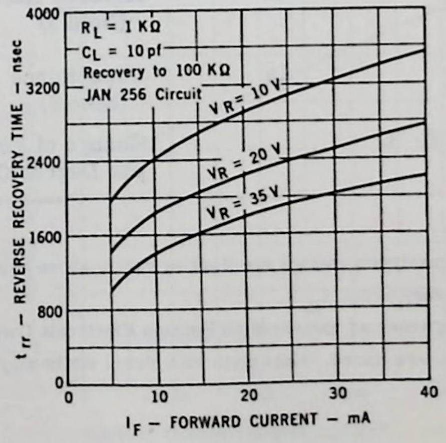
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



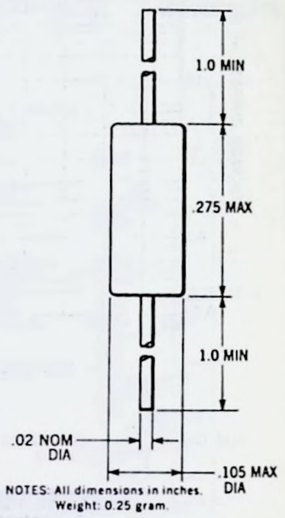
REVERSE RECOVERY TIME VERSUS FORWARD CURRENT AND REVERSE BIAS VOLTAGE

FD600

HIGH CONDUCTANCE, ULTRA-FAST PLANAR EPITAXIAL DIODE

GENERAL DESCRIPTION - The FD600 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Weight: 0.25 gram.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	50 Volts
I_o	Average Rectified Current	200 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 Amp
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μsec	4 Amps
P	Power Dissipation	400 mW
P	Power Dissipation	170 mW at 125°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	FACT Subgroup	Characteristic	Min.	Max.	Units	Test Conditions
*V_F	1a	Forward Voltage	0.87	1.00		I_F = 200 mA
V_F	1b	Forward Voltage	0.82	0.92		I_F = 100 mA
V_F	1b	Forward Voltage	0.76	0.86		I_F = 50 mA
V_F	1b	Forward Voltage	0.66	0.74		I_F = 10 mA
V_F	1b	Forward Voltage	0.54	0.62		I_F = 1 mA
I_R	1a	Reverse Current		0.1	μA	V_R = -50 V
I_R	1a	Reverse Current (150°C)		100	μA	V_R = -50 V
BV	1a	Breakdown Voltage	75			I_R = 5 μA
t_{rr}	1a	Reverse Recovery Time (Note 2)		4.0	ns	I_F = I_R = 10-200 mA RL = 100 Ω
t_{rr}	1a	Reverse Recovery Time (Note 2)		6.0	ns	I_F = I_R = 200-400 mA RL = 100 Ω
C_o	1a	Capacitance (Note 3)		2.5	pF	V_R = 0 V, f = 1 MHz
ΔVF/°C		Change of Forward Voltage per Degree Change in Temperature	-1.8 mV/°C Typical			

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 0.1 I_R

(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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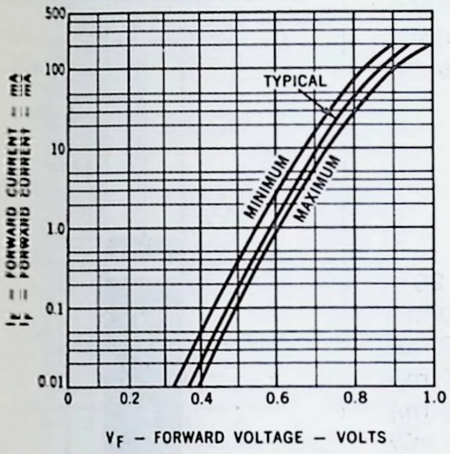
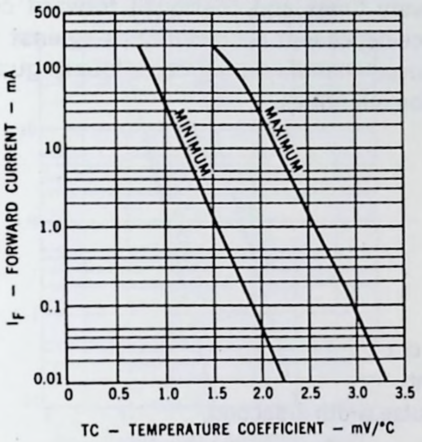
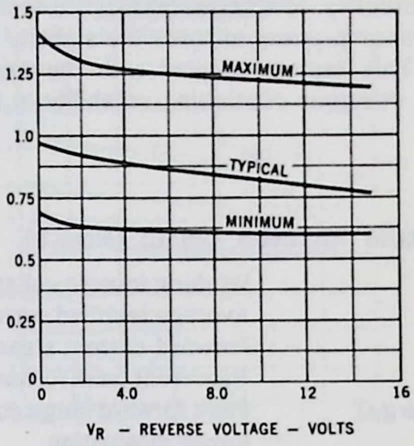
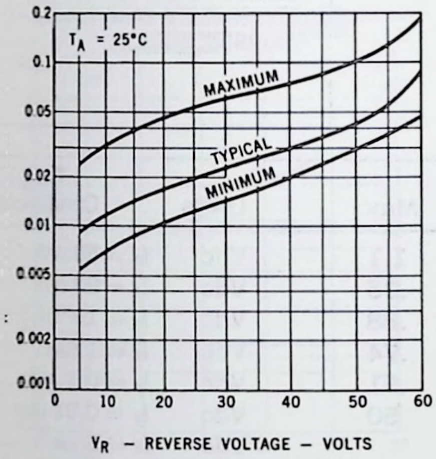
FAIRCHILD DIODE FD600

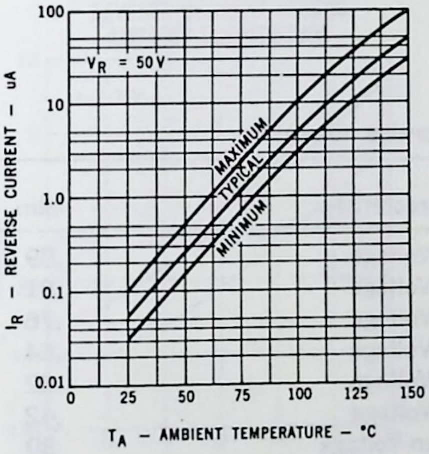
TYPICAL ELECTRICAL CHARACTERISTICS

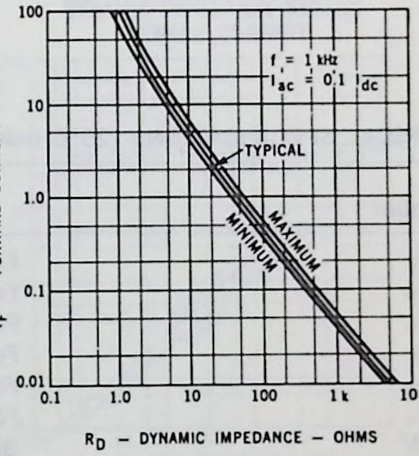

FORWARD VOLTAGE VERSUS FORWARD CURRENT

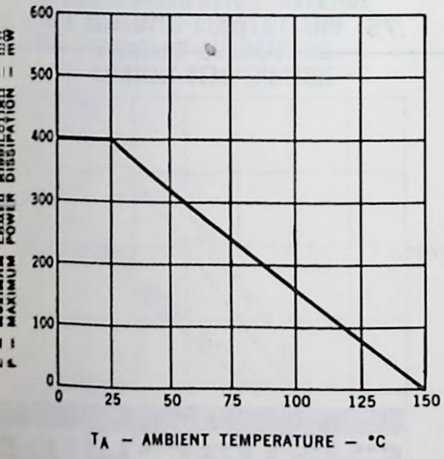

FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT

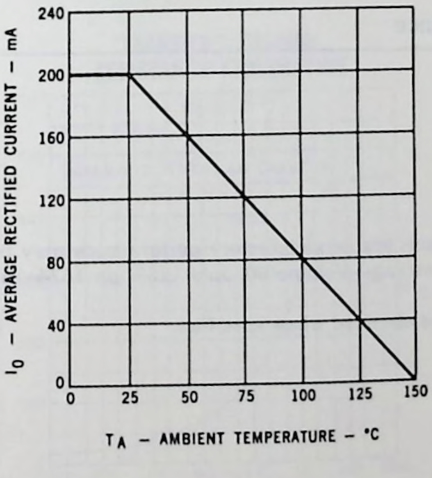

CAPACITANCE VERSUS REVERSE VOLTAGE

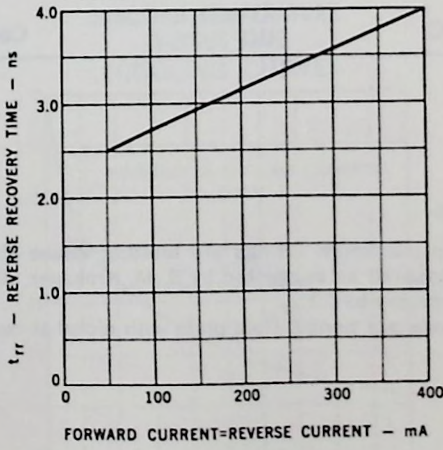

REVERSE VOLTAGE VERSUS REVERSE CURRENT


REVERSE CURRENT VERSUS AMBIENT TEMPERATURE


DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT


POWER DERATING CURVE


AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE


REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

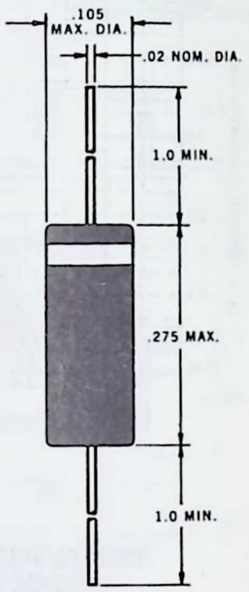
FD700

PICO-SECOND COMPUTER DIODE

GENERAL DESCRIPTION

The FD700 is a silicon planar epitaxial diode providing features necessary for ultra high speed logic circuitry: low capacitance, pico-second recovery times and controlled forward conductance. The planar process ensures the stability of surface-dependent characteristics against change with time. This factor, coupled with the most advanced manufacturing techniques, guarantees the circuit designer continuing reliability in production quantities.

PHYSICAL DIMENSIONS



NOTE: All dimensions in inches
See note 4.
Weight: 0.25 gram.

MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working inverse voltage	20 V
I_o	Average rectified current	50 mA
I_F	Forward current steady state d. c.	150 mA
i_f	Recurrent peak forward current	150 mA
i_f (surge)	Peak forward surge current, pulse width 1 second.	250 mA
P	Power dissipation	250 mW
$1/\theta$	Power derating factor	2 mW/°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

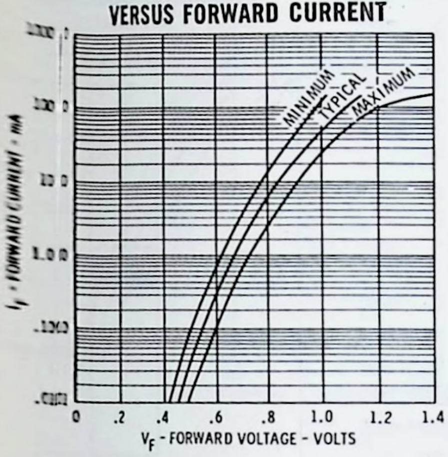
Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{F1}	Forward Voltage	.89	1.1	Vdc	$I_F = 50$ mA
V_{F2}	Forward Voltage	.81	.95	Vdc	$I_F = 20$ mA
V_{F3}	Forward Voltage	.76	.88	Vdc	$I_F = 10$ mA
V_{F4}	Forward Voltage	.64	.74	Vdc	$I_F = 1$ mA
V_{F5}	Forward Voltage	.52	.61	Vdc	$I_F = 0.1$ mA
V_{F6}	Forward Voltage	.42	.50	Vdc	$I_F = 0.01$ mA
BV	Breakdown Voltage	30		Vdc	$I_R = 5\ \mu$A
I_{R1}	Reverse Current		50	nA	$V_R = 20$ V
I_{R2}	Reverse Current (150°C)		50	μA	$V_R = 20$ V
τ	Minority Carrier Lifetime		450	ps	See Note 2
t_{rr}	Reverse Recovery Time [Note 3]		700	ps	$I_F = I_R = 10$ mA, RL = 100 Ω
C	Capacitance		.75	pF	$V_R = 0$, f = 1 MHz

NOTES:

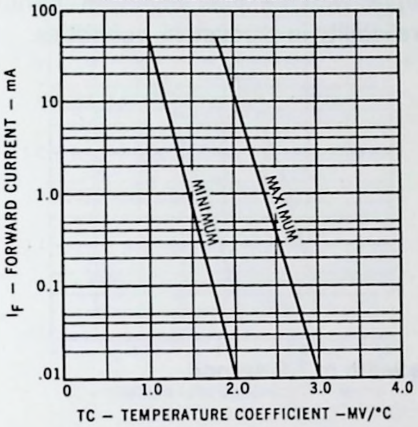
(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Measured as suggested by S. M. Krakauer, IRE Proceedings, Volume 60, July 1962, pp 1674–1675.
(3) Recovery to 0.1 I_R
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

TYPICAL ELECTRICAL CHARACTERISTICS

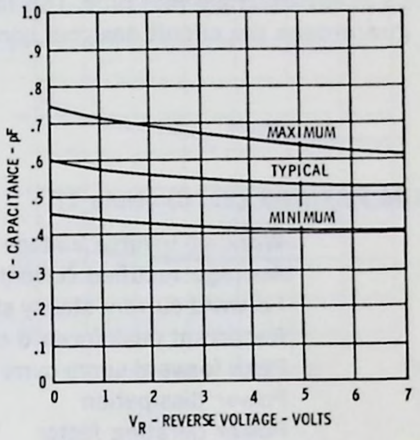
FORWARD VOLTAGE VERSUS FORWARD CURRENT



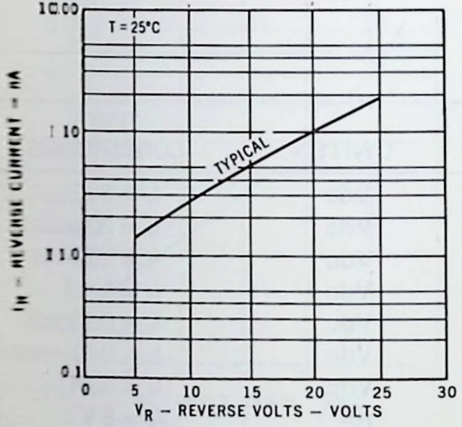
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



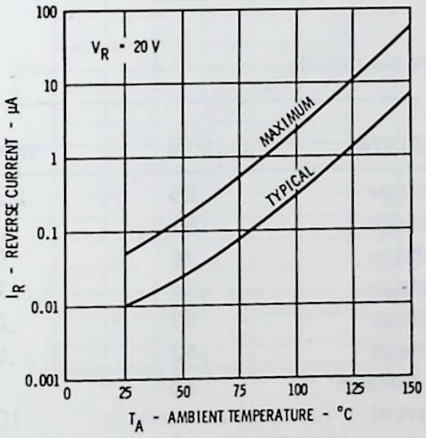
CAPACITANCE VERSUS REVERSE VOLTAGE



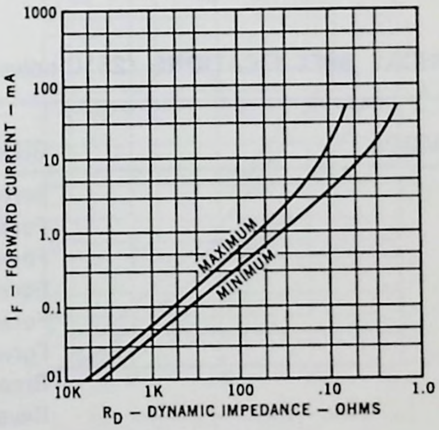
REVERSE VOLTAGE VERSUS REVERSE CURRENT



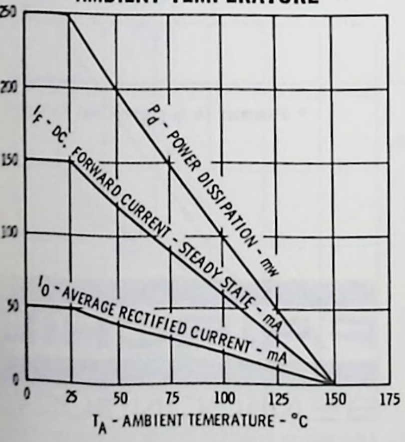
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



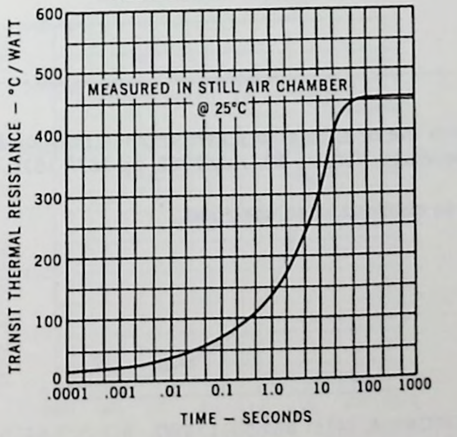
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



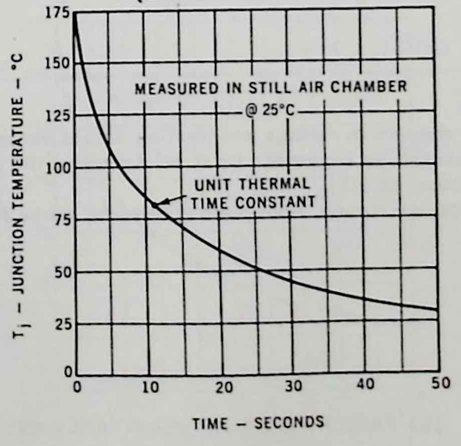
POWER DISSIPATION, AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VS AMBIENT TEMPERATURE



TRANSIENT THERMAL RESISTANCE VERSUS TIME



JUNCTION TEMPERATURE VERSUS TIME (COOLING CURVE)



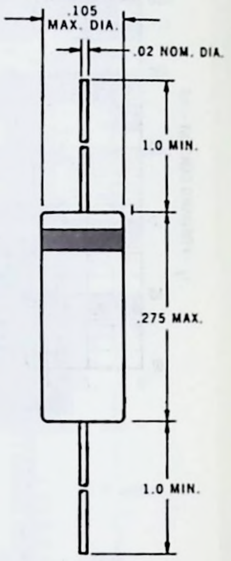
FD777

PICO-SECOND COMPUTER DIODE

GENERAL DESCRIPTION — The FD777 is a silicon, planar, epitaxial diode providing features necessary for ultra high speed computer logic circuitry; low capacitance, picosecond recovery times and controlled forward conductance. The planar process ensures the stability of surface-dependent characteristics against change with time. This factor, coupled with the most advanced manufacturing techniques, guarantees the circuit designer continuing reliability in production quantities.

PHYSICAL DIMENSIONS

DO-7 PACKAGE



NOTE: All dimensions in inches. See note 4

MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	8 V
I_o	Average rectified current	50 mA
I_F	Forward current steady state DC	150 mA
i_f	Recurrent peak forward current	150 mA
i_f (surge)	Peak forward surge current, pulse width of 1.0 second	250 mA
P	Power dissipation	250 mW
$1/\theta$	Power derating factor	2 mW/°C
T_A	Operating temperature	−65°C to +150°C
T_{stg}	Storage temperature, ambient	−65°C to +175°C

ELECTRICAL SPECIFICATIONS (25°C unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage	.89	1.35	Vdc	$I_F = 50$ mA
V_{F2}	Forward Voltage	.81	1.0	Vdc	$I_F = 20$ mA
V_{F3}	Forward Voltage	.76	.94	Vdc	$I_F = 10$ mA
V_{F4}	Forward Voltage	.64	.79	Vdc	$I_F = 1$ mA
V_{F5}	Forward Voltage	.52	.64	Vdc	$I_F = 0.1$ mA
V_{F6}	Forward Voltage	.42	.53	Vdc	$I_F = 0.01$ mA
BV	Breakdown Voltage	15		Vdc	$I_R = 5\ \mu A$
I_{R1}	Reverse Current		100	nA	$V_R = 8$ V
I_{R2}	Reverse Current (150°C)		50	μA	$V_R = 8$ V
τ	Minority Carrier Lifetime		450	ps	See Note 2
t_{rr}	Reverse Recovery Time [Note 3]		750	ps	$I_F = I_R = 10$ mA, RL = 100 Ω
C	Capacitance		1.3	pF	$V_R = 0$, f=1.0MHz

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Measured as suggested by S. M. Krakauer, IRE Proceedings, Volume 60, July 1962, pp 1674-1675.
(3) Recovery to 0.1 I_R.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

* Planar is a patented Fairchild process

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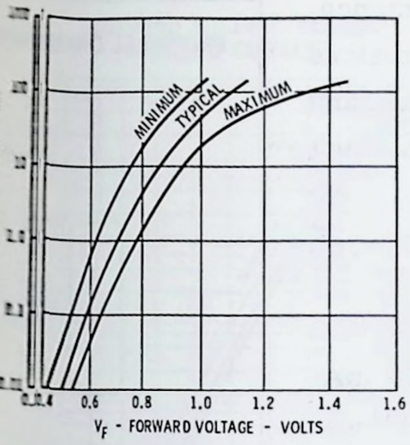
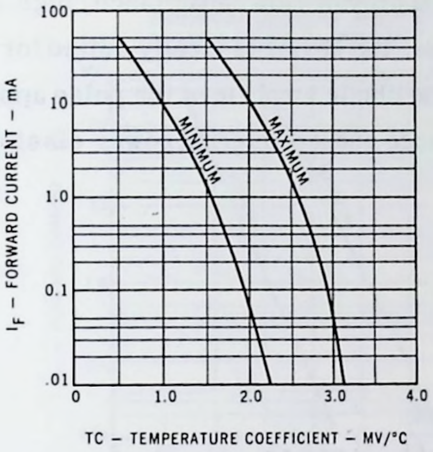
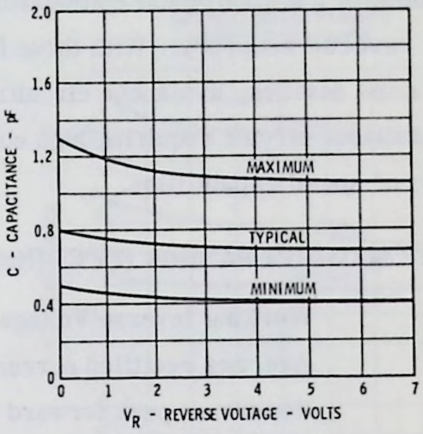
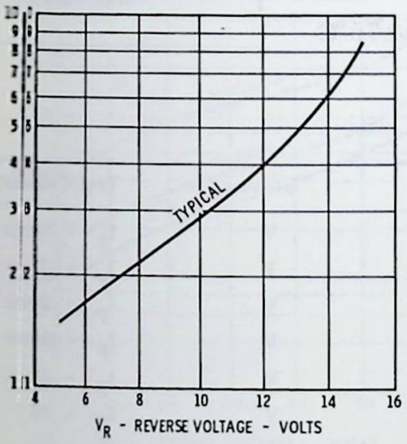
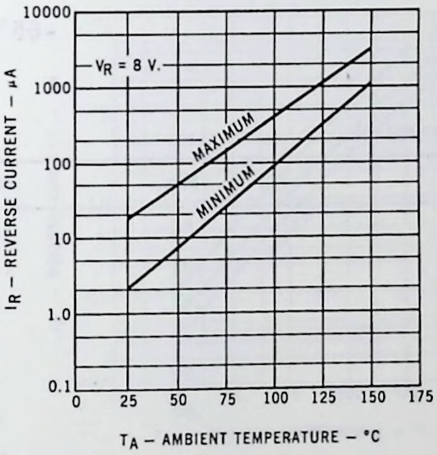
TYPICAL ELECTRICAL CHARACTERISTICS

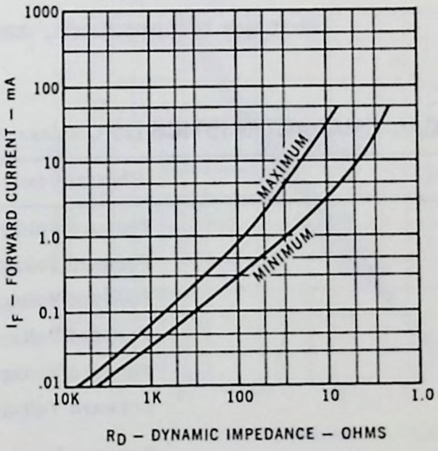

FORWARD CURRENT VERSUS FORWARD VOLTAGE

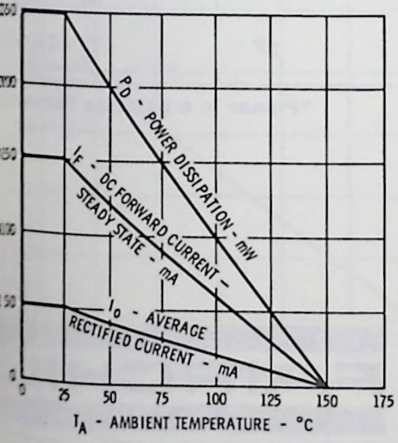

FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT

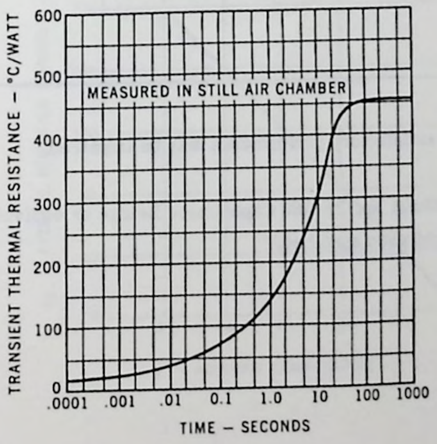

CAPACITANCE VERSUS REVERSE VOLTAGE

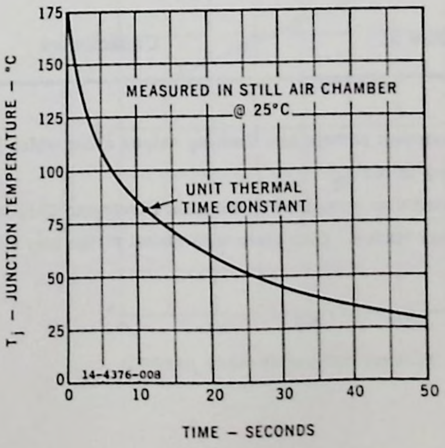

REVERSE CURRENT VERSUS REVERSE VOLTAGE


REVERSE CURRENT VERSUS AMBIENT TEMPERATURE


DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT


POWER DISSIPATION AND AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE


TRANSIENT THERMAL RESISTANCE VERSUS TIME

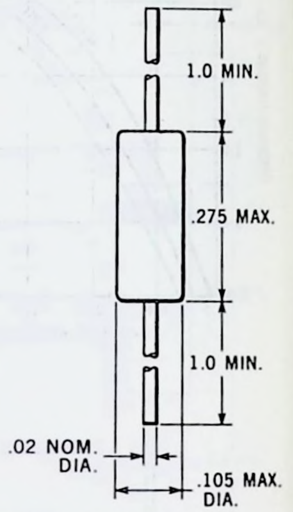

JUNCTION TEMPERATURE VERSUS TIME (COOLING CURVE)

FD6666

HIGH CONDUCTANCE ULTRA FAST EPITAXIAL PLANAR* DIODE

The FD 6666 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
See note 4.
Weight: 0.25 gram.

ABSOLUTE MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	50 V
I_o	Average rectified current	200 mA
i_f	Recurrent peak forward current	600 mA
i_f(surge)	Peak forward surge current pulse width of 1 second	1 A
i_f(surge)	Peak forward surge current pulse width of 1 μs	4 A
P	Power dissipation	400 mW
$\frac{1}{\theta}$	Power derating factor	3.2 mW/°C
T_A	Operating temperature	-65°C to +150°C
T_{stg}	Storage temperature, ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage	.86	1.10	V	I_F = 300 mA
V_F	Forward Voltage	.85	1.05	V	I_F = 250 mA
V_F	Forward Voltage	.83	1.00	V	I_F = 200 mA
V_F	Forward Voltage	.82	.94	V	I_F = 150 mA
V_F	Forward Voltage	.80	.90	V	I_F = 100 mA
V_F	Forward Voltage	.65	.75	V	I_F = 10 mA
I_R	Reverse Current		100	nA	V_R = −55 V
I_R (100°C)	Reverse Current		20	μA	V_R = −55 V
BV	Breakdown Voltage	75		V	I_R = 5 μA
t_{rr}(Note 2)	Reverse Recovery Time		5	ns	I_F = 10 mA I_R = 10 mA R_L = 100 Ω
C_o (Note 3)	Capacitance		5	pF	V_R = 0 V, f = 1MHz

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Recovery to 0.1 I_R.

(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

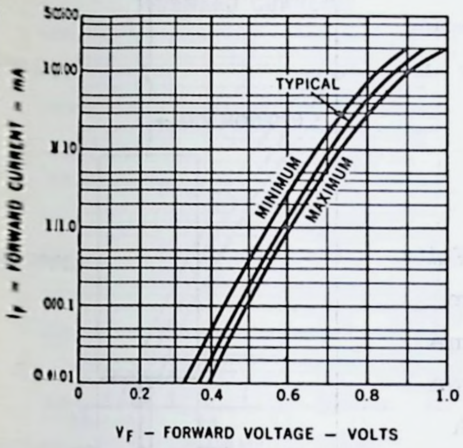
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

*Planar is a patented Fairchild proces

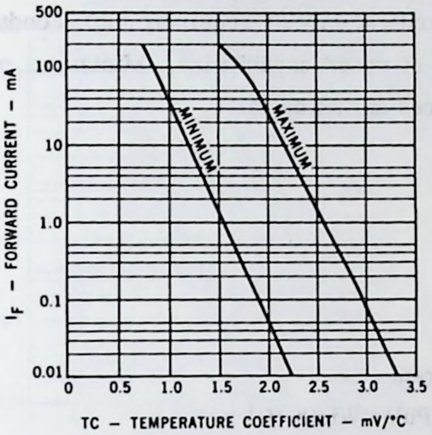
HIGH CONDUCTANCE ULTRA FAST EPITAXIAL PLANAR* DIODE

TYPICAL ELECTRICAL CHARACTERISTICS

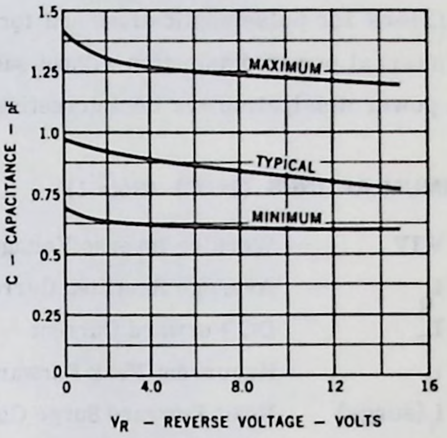
FORWARD VOLTAGE VERSUS FORWARD CURRENT



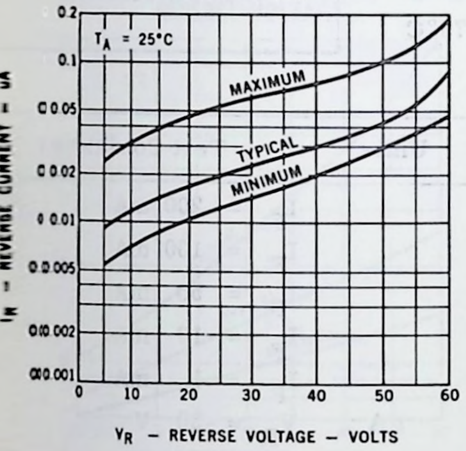
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



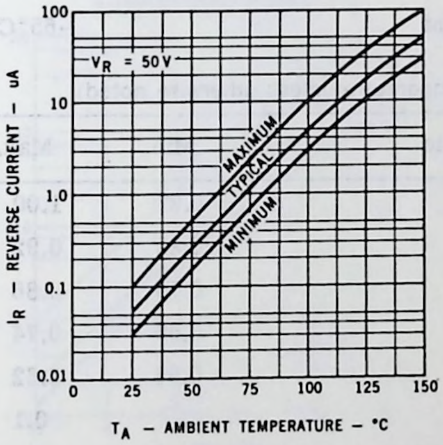
CAPACITANCE VERSUS REVERSE VOLTAGE



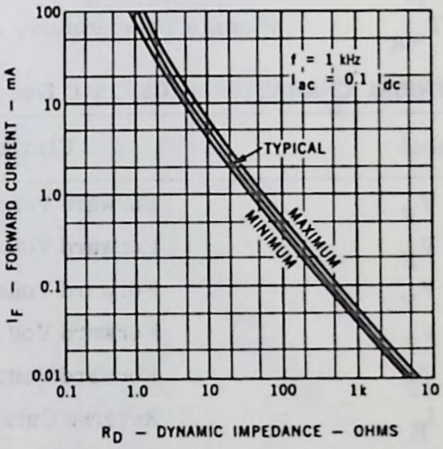
REVERSE CURRENT VERSUS REVERSE VOLTAGE



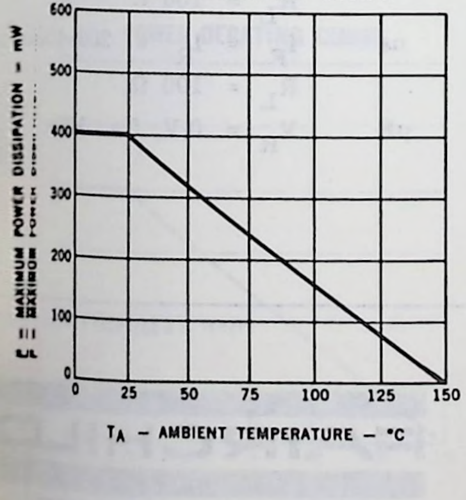
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



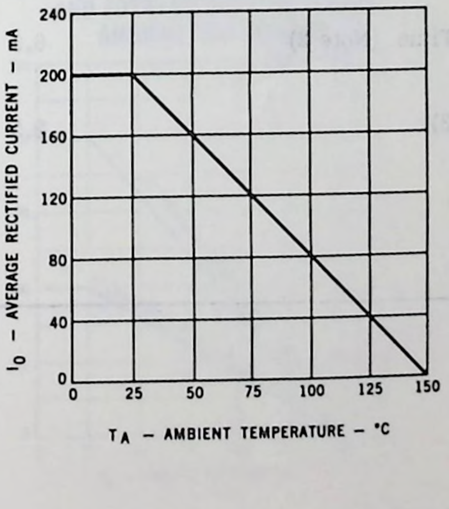
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



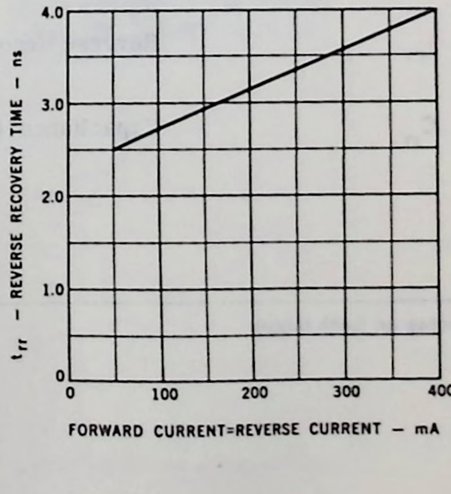
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

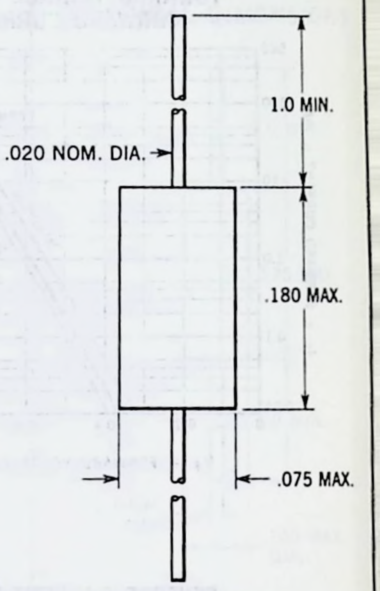


FDH600

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA-FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION – The miniature FDH600 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and high power dissipation are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	50 Volts
I_o	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	4 A
P	Power Dissipation	400 mW
P	Power Dissipation	100 mW at 125°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage	0.87	1.00		I_F = 200 mA
V_F	Forward Voltage	0.82	0.92		I_F = 100 mA
V_F	Forward Voltage	0.76	0.86		I_F = 50 mA
V_F	Forward Voltage	0.66	0.74		I_F = 10 mA
V_F	Forward Voltage	0.54	0.62		I_F = 1 mA
I_R	Reverse Current		0.1	μA	V_R = -50 V
I_R	Reverse Current (150°C)		100	μA	V_R = -50 V
BV	Breakdown Voltage	75			I_R = 5 μA
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	I_F = I_R = 10-200 mA R_L = 100 Ω
t_{rr}	Reverse Recovery Time (Note 2)		6.0	ns	I_F = I_R = 200-400 mA R_L = 100 Ω
C_o	Capacitance (Note 3)		2.5	pF	V_R = 0 V, f = 1 MHz

(See notes on back page)

* Planar is a patented Fairchild process

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FAIRCHILD DIODE FDH600

TES:

The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

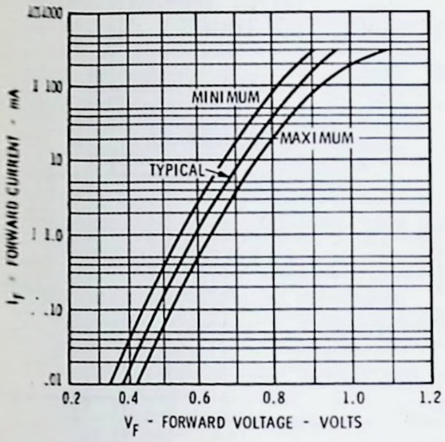
Recovery to 0.1 I_R.

Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

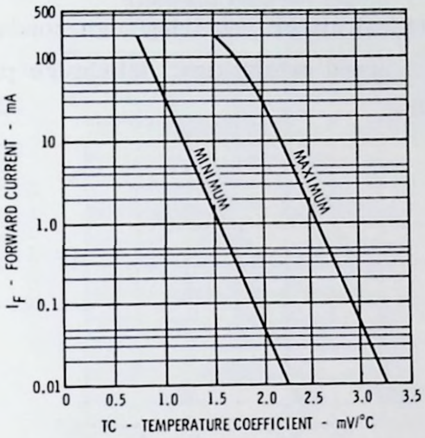
Leads are tinned. Gold plate with nickel strike may be obtained when specified.

TYPICAL ELECTRICAL CHARACTERISTICS

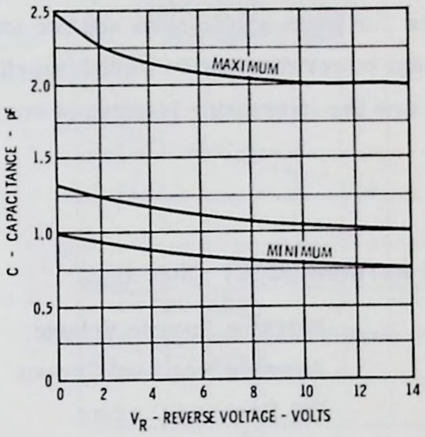
FORWARD VOLTAGE VERSUS FORWARD CURRENT



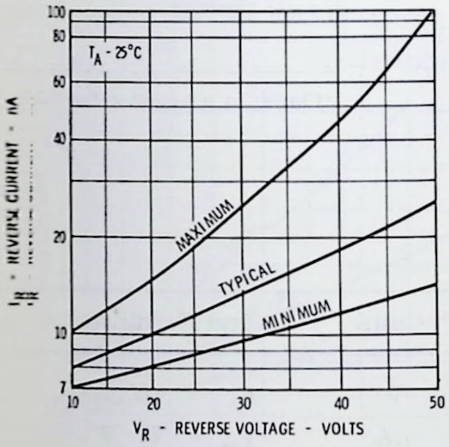
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



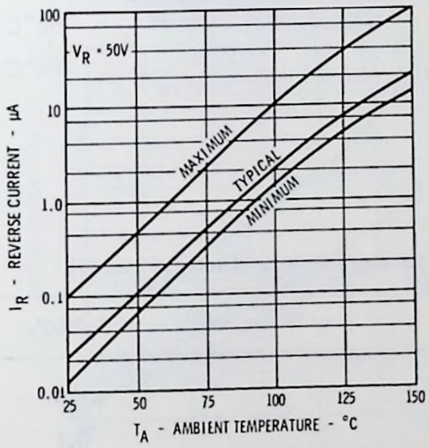
CAPACITANCE VERSUS REVERSE VOLTAGE



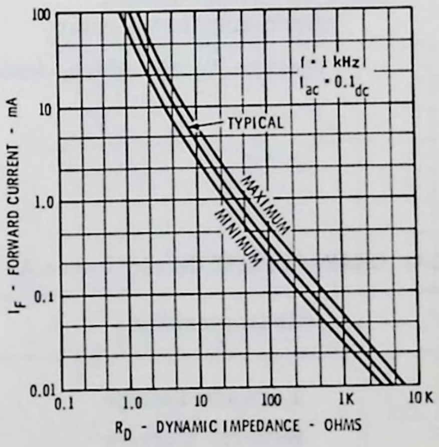
REVERSE CURRENT VERSUS REVERSE VOLTAGE



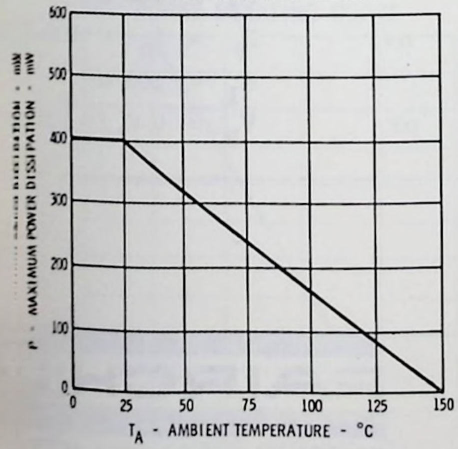
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



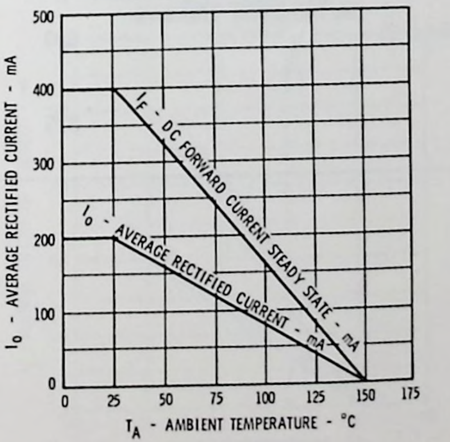
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



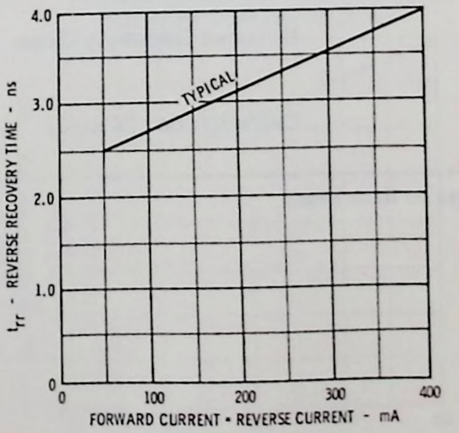
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

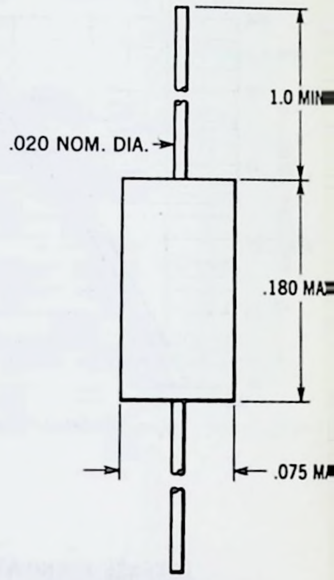


FDH66

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA-FAS
ECONOMICAL PLANAR* EPITAXIAL DIOD

GENERAL DESCRIPTION The miniature FDH666 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core drivers, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and economy are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

*Planar is a patented Fairchild proc

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	25 Volts
I_o	Average Rectified Current	100 mA
I_F	DC Forward Current	200 mA
i_f	Recurrent Peak Forward Current	300 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	2 A
P	Power Dissipation	250 mW
T_A	Operating Temperature	-65°C to +100°C
T_{stg}	Storage Temperature, Ambient	-65°C to +150°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage		1.00	V	I_F = 100 mA
I_R	Reverse Current		0.1	μA	V_R = -25 V
I_R	Reverse Current (100°C)		100	μA	V_R = -25 V
BV	Breakdown Voltage	40		V	I_R = 5 μA
t_{rr1}	Reverse Recovery Time (Note 2)		4.0	ns	I_F = I_R = 10-200 m R_L = 100 Ω
t_{rr2}	Reverse Recovery Time (Note 2)		6.0	ns	I_F = I_R = 200-400 R_L = 100 Ω
C_o	Capacitance (Note 3)		3.5	pF	V_R = 0 V, f = 1 MHz

(See notes on back page)

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FAIRCHILD DIODE FDH666

NOTES:

maximum ratings are limiting values above which life or satisfactory performance may be impaired.

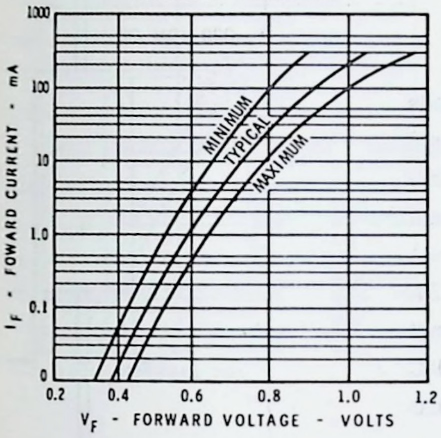
Recovery to 0.1 I_R.

Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

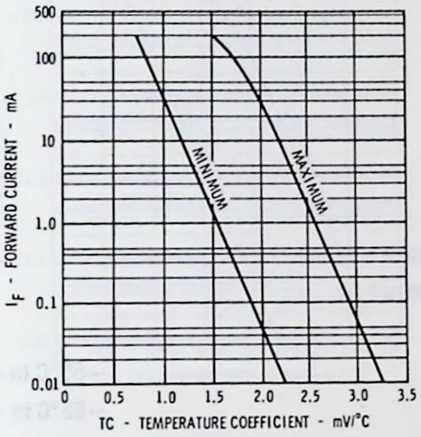
Leads are tinned. Gold plate with nickel strike may be obtained when specified.

TYPICAL ELECTRICAL CHARACTERISTICS

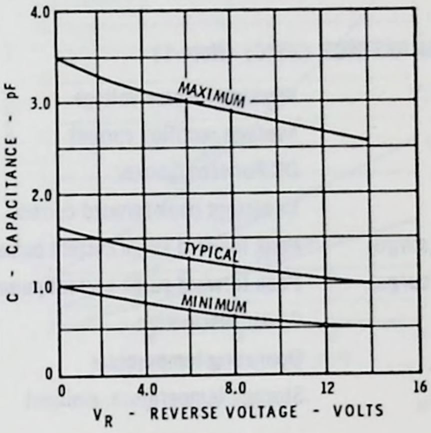
FORWARD VOLTAGE VERSUS FORWARD CURRENT



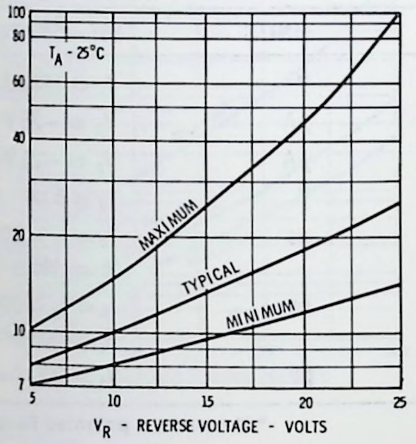
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



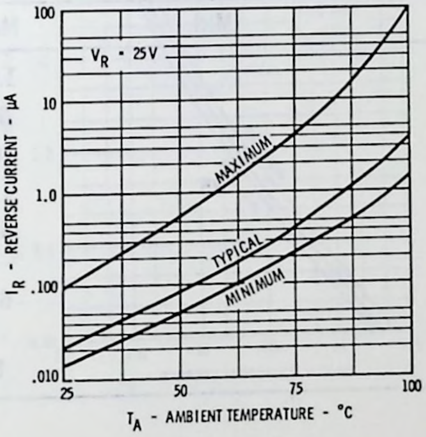
CAPACITANCE VERSUS REVERSE VOLTAGE



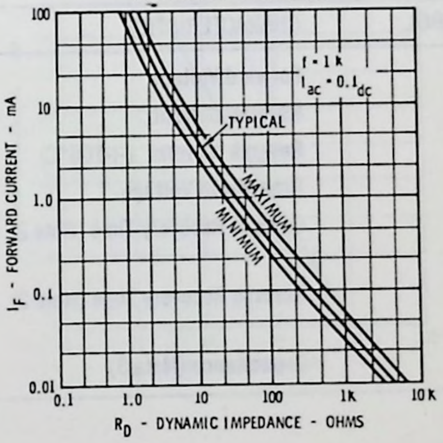
REVERSE CURRENT VERSUS REVERSE VOLTAGE



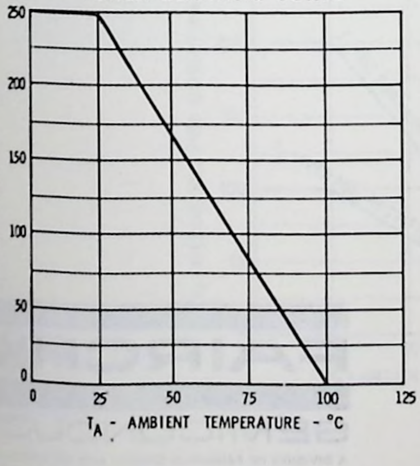
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



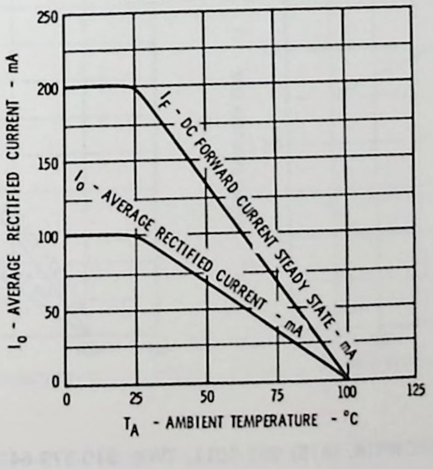
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



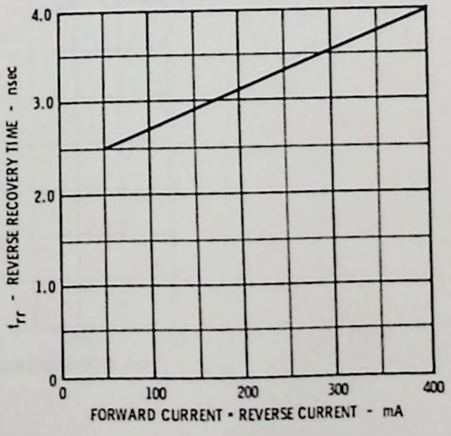
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



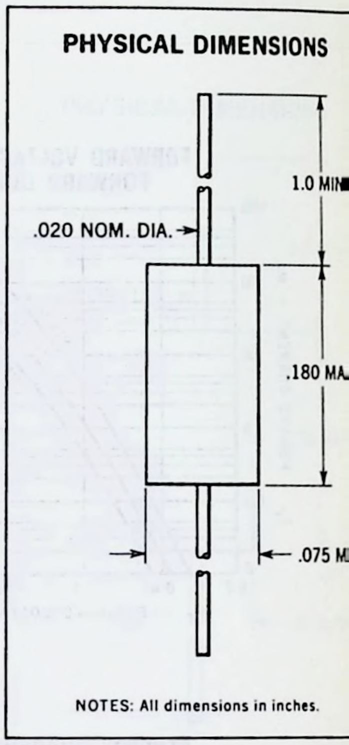
REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)



FDH694

MINIATURE SIZE, HIGH CONDUCTANCE, ULTRA-FAST ECONOMICAL PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The miniature FDH694 is a silicon planar epitaxial diode that provides high conductance and fast reverse recovery. With these features, the device is ideally suited for applications such as core drivers, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and economy are the interesting features of this device.


PHYSICAL DIMENSIONS

NOTES: All dimensions in inches.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	25 Volts
I_O	Average rectified current	100 mA
I_F	DC Forward Current	200 mA
i_f	Recurrent peak forward current	300 mA
i_f(surge)	Peak forward surge current pulse width of 1 second	500 mA
i_f(surge)	Peak forward surge current pulse width of 1 μs	2 A
P	Power dissipation	250 mW
T_A	Operating temperature	−65°C to +100°C
T_{stg}	Storage temperature, ambient	−65°C to +150°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.00	V	$I_F = 100$ mA
I_R	Reverse Current		0.1	μA	$V_R = -25$ V
I_R	Reverse Current (+100°C)		100	μA	$V_R = -25$ V
BV	Breakdown Voltage	35		V	$I_R = 5\ \mu$A
t_{rr1}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R = 10$-200 mA $R_L = 100\ \Omega$
t_{rr2}	Reverse Recovery Time (Note 2)		6.0	ns	$I_F = I_R = 200$-400 m $R_L = 100\ \Omega$
C_o	Capacitance (Note 3)		5	pF	$V_R = 0$ V, f = 1 MHz

*Planar is a patented Fairchild pro

NOTES:

(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
(2) Recovery to 0.1 I_F.
(3) Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
(4) Leads are tinned. Gold plate with nickel strike may be obtained when specified.

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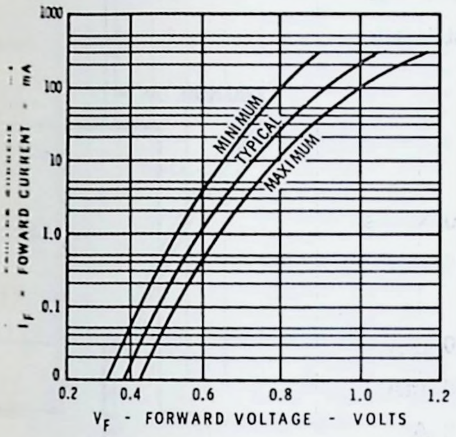
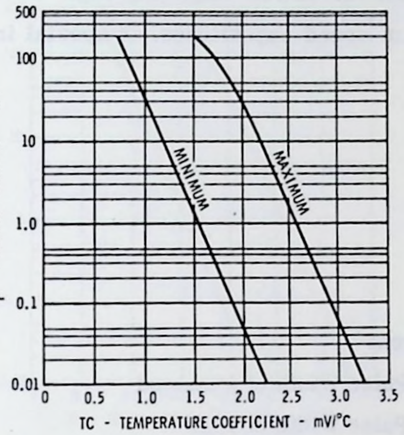
FAIRCHILD DIODE FDH694

TYPICAL ELECTRICAL CHARACTERISTICS

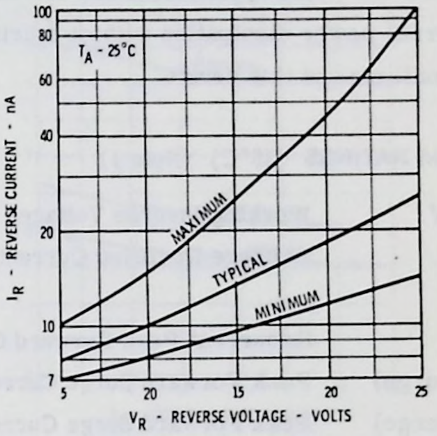
FORWARD VOLTAGE VERSUS FORWARD CURRENT



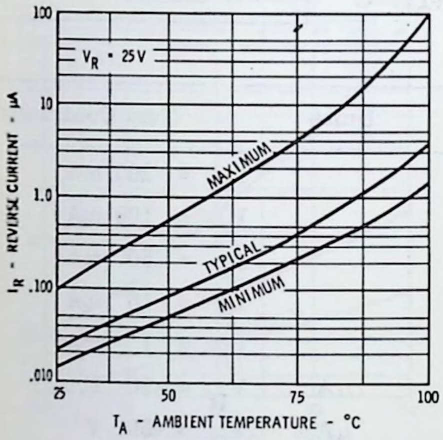
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



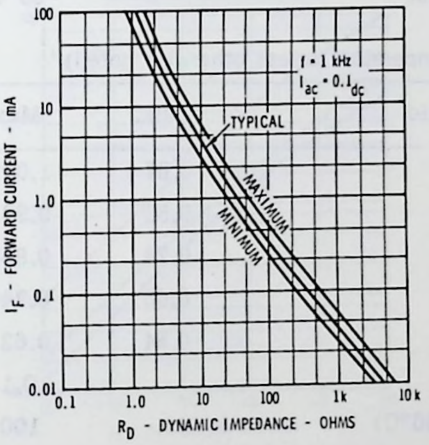
REVERSE CURRENT VERSUS REVERSE VOLTAGE



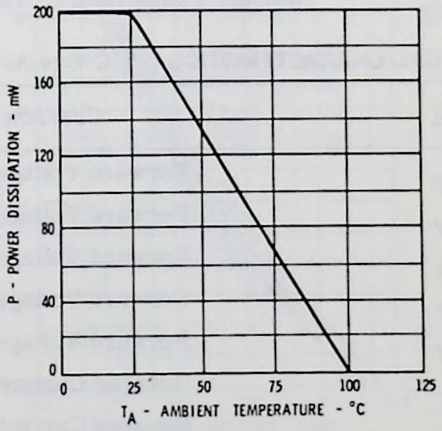
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



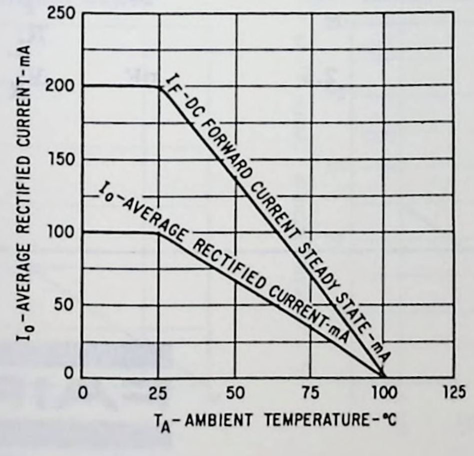
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



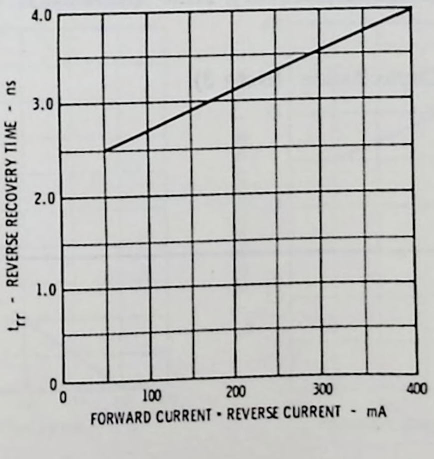
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

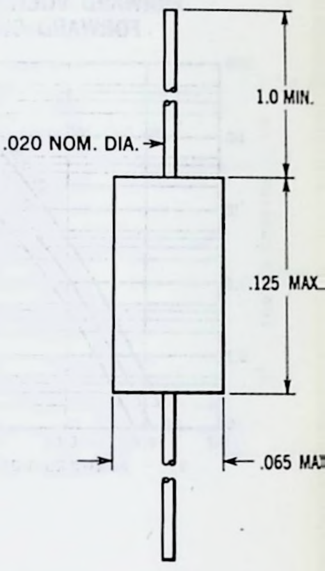


FDN600

ULTRA COMPACT, HIGH CONDUCTANCE ULTRA-FAST PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION – The miniature FDN600 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core devices, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Of special interest is the ultra-small size of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 Volts
I_o	Average Rectified Current	125 mA
i_f	Recurrent Peak Forward Current	400 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	2 A
P	Power Dissipation (Package)	350 mW
$1/\theta$	Power Derating Factor	2.8 mW/°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage	0.87	1.00		I_F = 200 mA
V_F	Forward Voltage	0.82	0.92		I_F = 100 mA
V_F	Forward Voltage	0.76	0.86		I_F = 50 mA
V_F	Forward Voltage	0.66	0.74		I_F = 10 mA
V_F	Forward Voltage	0.54	0.62		I_F = 1 mA
I_R	Reverse Current		0.1	μA	V_R = -50 V
I_R	Reverse Current (150°C)		100	μA	V_R = -50 V
BV	Breakdown Voltage	75			I_R = 5 μA
t_{rr}	Reverse Recovery Time (Note 2)		4.0	ns	I_F = I_R = 10-200 mA R_L = 100 Ω
t_{rr}	Reverse Recovery Time (Note 2)		6.0	ns	I_F = I_R = 200-400 m R_L = 100 Ω
C_o	Capacitance (Note 3)		2.5	pF	V_R = 0 V, f = 1 MHz

(See notes on back page)

* Planar is a patented Fairchild pr

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FAIRCHILD DIODE FDN600

NOTES:

These maximum ratings are limiting values above which life or satisfactory performance may be impaired.

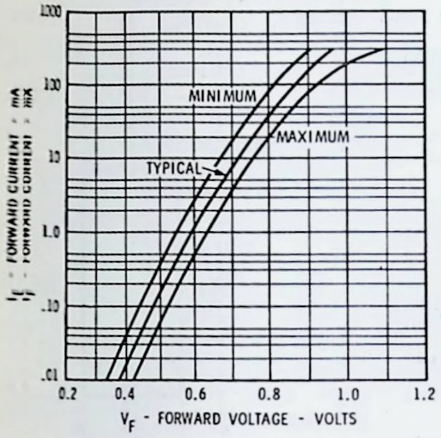
Recovery to 0.1 I_F.

Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

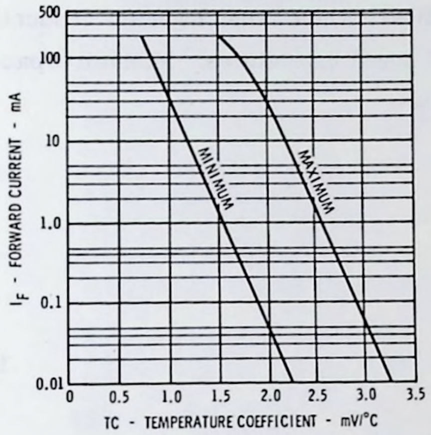
Leads are tinned. Gold plate with nickel strike may be obtained when specified.

TYPICAL ELECTRICAL CHARACTERISTICS

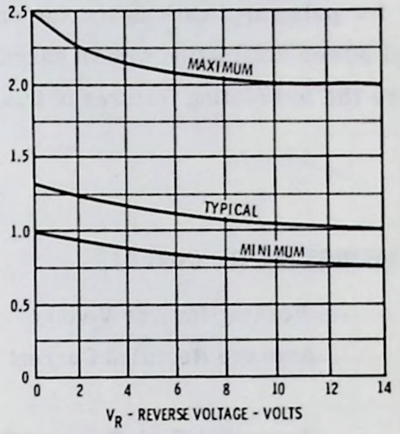
FORWARD VOLTAGE VERSUS FORWARD CURRENT



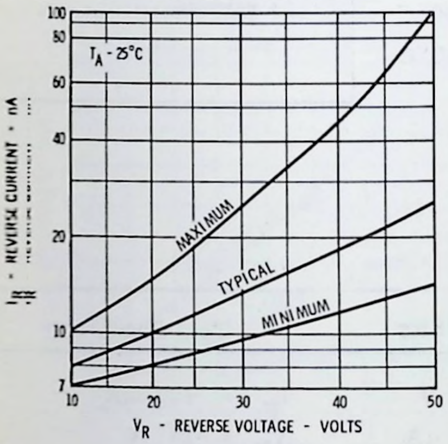
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



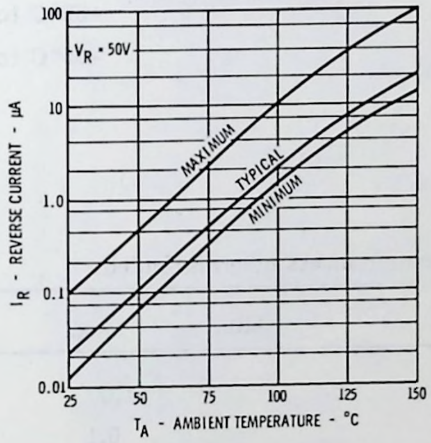
CAPACITANCE VERSUS REVERSE VOLTAGE



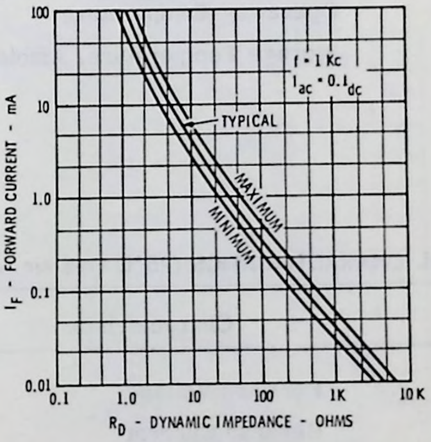
REVERSE CURRENT VERSUS REVERSE VOLTAGE



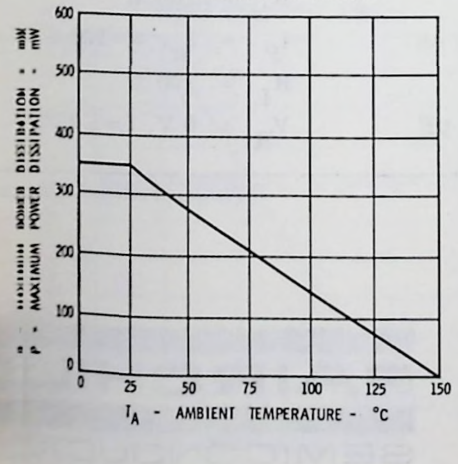
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



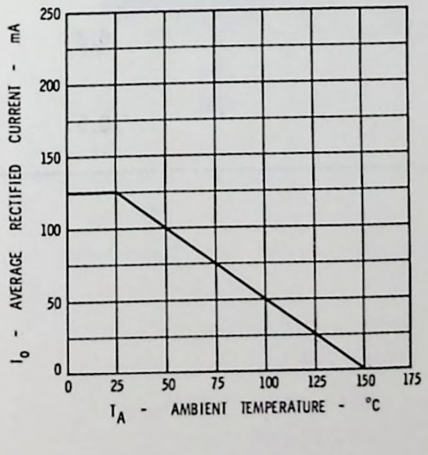
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



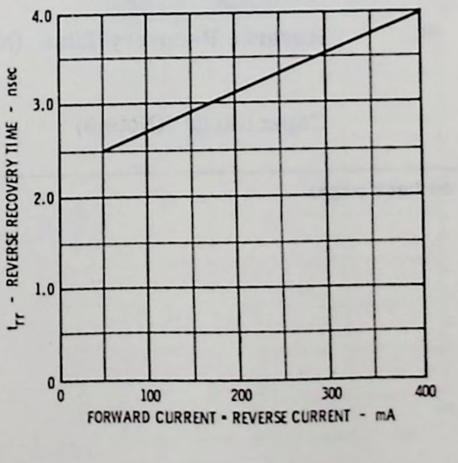
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)

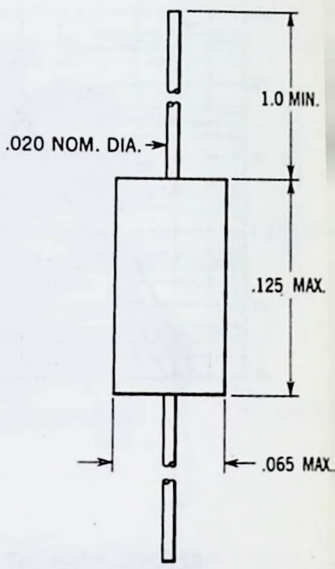


FDN666

ULTRA COMPACT, HIGH CONDUCTANCE, ULTRA-FAST ECONOMICAL PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION - The miniature FDN666 is a silicon planar epitaxial diode that provides low capacitance, high conductance, and fast reverse recovery. With these features, the device is ideally suited for applications such as core drivers, avalanche circuitry, logarithmic amplifiers for pulse applications and for any critical circuit requiring high conductance and low internal power dissipation without sacrifice of speed capabilities. Miniature package and economy are the interesting features of this device.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	25 Volts
I_o	Average Rectified Current	100 mA
i_f	Recurrent Peak Forward Current	200 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 second	400 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1 μs	1 A
P	Power Dissipation (Package)	250 mW
T_A	Operating Temperature	-65°C to +100°C
T_{stg}	Storage Temperature, Ambient	-65°C to +150°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_F	Forward Voltage		1.00	V	I_F = 100 mA
I_R	Reverse Current		0.1	μA	V_R = -25 V
I_R	Reverse Current (100°C)		100	μA	V_R = -25 V
BV	Breakdown Voltage	40		V	I_R = 5 μA
t_{rr1}	Reverse Recovery Time (Note 2)		4.0	ns	I_F = I_R = 10-200 mA R_L = 100 Ω
t_{rr2}	Reverse Recovery Time (Note 2)		6.0	ns	I_F = I_R = 200-400 mA R_L = 100 Ω
C_o	Capacitance (Note 3)		3.5	pF	V_R = 0 V, f = 1 MHz

(See notes on back page)

* Planar is a patented Fairchild pro

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FAIRCHILD DIODE FDN666

NOTES:

These maximum ratings are limiting values above which life or satisfactory performance may be impaired.

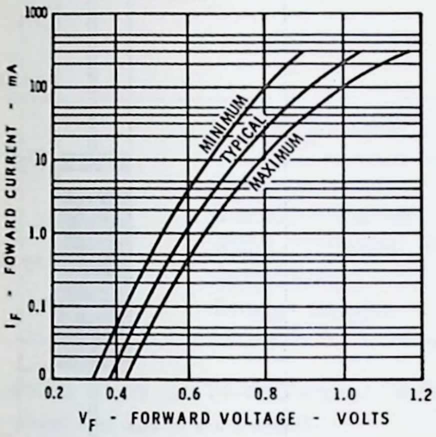
Recovery to 0.1 I_F.

Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.

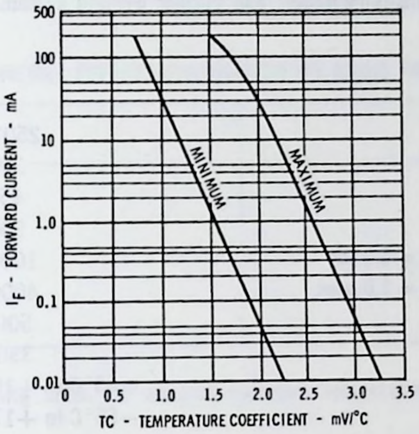
Leads are tinned. Gold plate with nickel strike may be obtained when specified.

TYPICAL ELECTRICAL CHARACTERISTICS

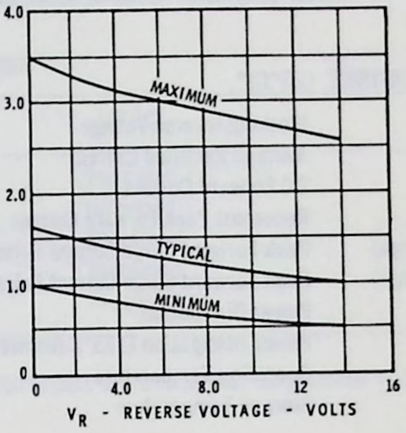
FORWARD VOLTAGE VERSUS FORWARD CURRENT



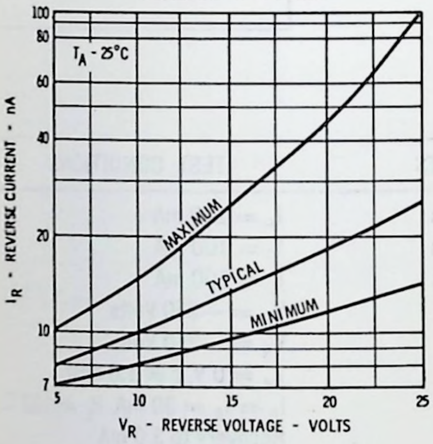
FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



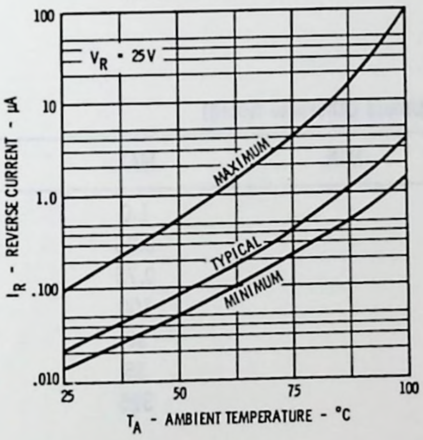
CAPACITANCE VERSUS REVERSE VOLTAGE



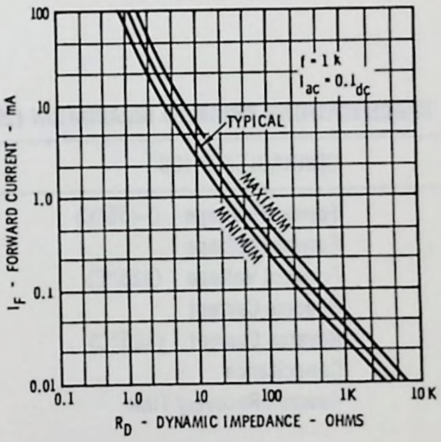
REVERSE CURRENT VERSUS REVERSE VOLTAGE



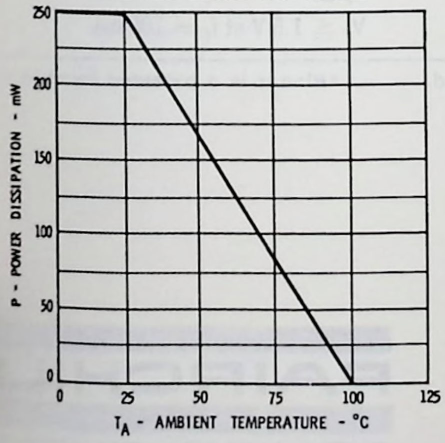
REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



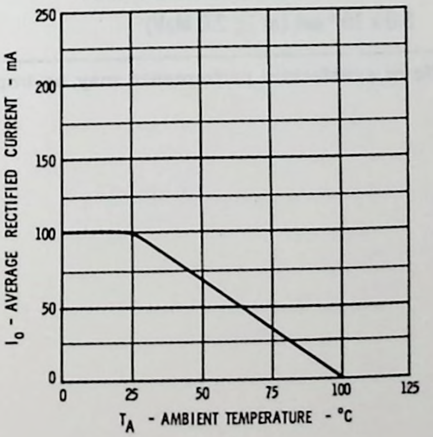
DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



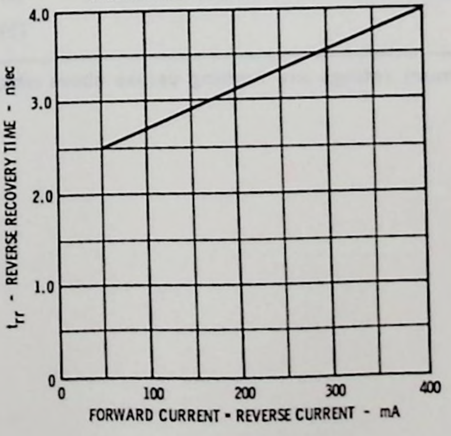
POWER DERATING CURVE



AVERAGE RECTIFIED CURRENT VERSUS AMBIENT TEMPERATURE



REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)



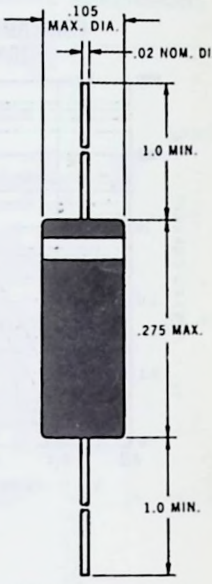
FDR300

RADIATION RESISTANT SILICON PLANAR* RECTIFIER

GENERAL DESCRIPTION —The FDR300 is of special design for radiation resistance, and this unique design permits it to withstand a 5-Amp reverse pulse, to have breakdown voltages as high as 400 volts, and still guarantee forward voltage drop less than 1.5 volts at 100 mA after neutron irradiation of 1 x 10^{15} nvt.

This high-reliability device is ideal for any application where high-voltage, radiation-tolerant devices are required; such as nuclear propulsion systems, space satellite instrumentation, and nuclear weapon systems.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Weight: 0.25 gram.

MAXIMUM RATINGS (25°C)*

WIV	Working Inverse Voltage	250 Volts
I_O	Average Rectified Current	300 mA
I_F	DC Forward Current	450 mA
i_f	Recurrent Peak Forward Current	900 mA
i_f (surge)	Peak Forward Surge Current Pulse Width = 1.0 sec	1000 mA
i_f (surge)	Peak Forward Surge Current Pulse Width = 1.0 μsec	4000 mA
P	Power Dissipation	500 mW
P	Power Dissipation (125°C Ambient)	330 mW
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature	−65°C to +175°C

ELECTRICAL SPECIFICATIONS PRIOR TO IRRADIATION (25°C Unless Otherwise Noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage (—55°C)		1.0	Volts	$I_F = 100$ mA
V_{F2}	Forward Voltage		0.85	Volts	$I_F = 100$ mA
V_{F3}	Forward Voltage (125°C)		0.75	Volts	$I_F = 100$ mA
I_{R1}	Reverse Current		100	nA	$V_R = -250$ Volts
I_{R2}	Reverse Current (125°C)		30	μA	$V_R = -250$ Volts
C	Capacitance		35	pF	$V_R = 0$ V, f = 1.0 MHz
t_{rr}	Reverse Recovery Time		325	ns	$I_F = I_R = 30$ mA, $R_L = 100\,\Omega$, Recovery to 3.0 mA

RADIATION TOLERANCE (See Notes on Back Page)

Radiation Threshold		5.0 x 10^{14} nvt	$V_F \leqq 1.0$ V at $I_F = 100$ mA
End of Life Dosage	(a)	1.0 x 10^{15} nvt (at ≧ 10 KeV)	$V_F \leqq 1.5$ V at $I_F = 100$ mA
	(b)	5.0 x 10^{16} evt (at ≧ 2.0 MeV)	$V_F \leqq 1.5$ V at $I_F = 100$ mA

*The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

*Planar is a patented Fairchild process.

RADIATION RESISTANT SILICON PLANAR RECTIFIER FDR300

ONS:

Threshold:	That radiation dosage above which the electrical parameters of a diode begin to change rapidly.
	A term defining an integrated dosage of neutron radiation. The number of neutrons per cm² with some average velocity for some time period.
	A term defining an integrated dosage of electron radiation. The number of electrons per cm² with some average velocity for some time period.
KeV:	Terms defining the energy level per bombarding particle: MeV = one million electronvolts KeV = one thousand electronvolts

GENERAL EFFECT OF RADIATION ON DIODE PARAMETERS

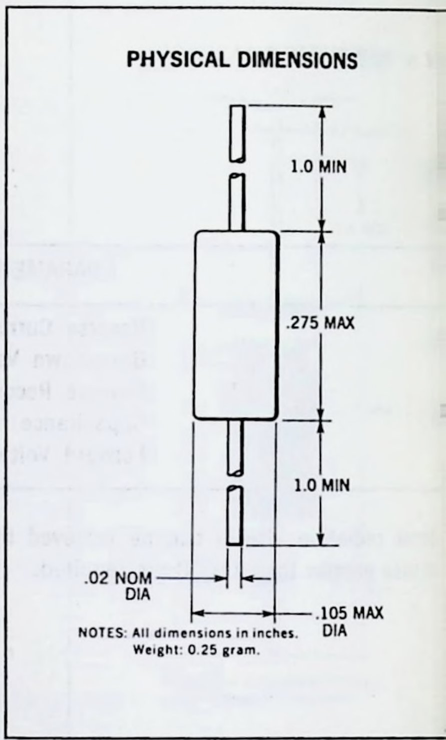
PARAMETERS	EFFECT
Reverse Current	Increased
Breakdown Voltage	Increased
Reverse Recovery Time	Decreased
Capacitance	Decreased
Forward Voltage	Increased

st radiation effects can be removed by an annealing bake. For neutron radiation, temperatures of 250°C-300°C are required; for electron radiation, temperatures greater than 150°C are required.

FDR600

RADIATION RESISTANT, HIGH CONDUCTANCE, ULTRA-FAST, PLANAR* EPITAXIAL DIODE

GENERAL DESCRIPTION — The FDR600 is a silicon, planar, epitaxial diode, specially designed to be radiation resistant. This high reliability device provides low capacitance, high conductance, and fast recovery time. It is ideally suited for applications such as nuclear propulsion systems, space satellite instrumentation, and nuclear weapons systems.



PHYSICAL DIMENSIONS

NOTES: All dimensions in inches.
Weight: 0.25 gram.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	50 Volts
I_O	Average Rectified Current	200 mA
I_F	DC Forward Current	400 mA
i_f	Recurrent Peak Forward Current	600 mA
i_f(surge)	Peak Forward Surge Current Pulse Width = 1 sec.	1 A
i_f(surge)	Peak Forward Surge Current Pulse Width = 1 μs	4 A
P	Power Dissipation	500 mW
P	Power Dissipation (125°C Ambient)	100 mW
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Unless Otherwise Noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage	0.87	1.00	Volts	$I_F = 200$ mA
V_{F2}	Forward Voltage	0.82	0.92	Volts	$I_F = 100$ mA
V_{F3}	Forward Voltage	0.76	0.86	Volts	$I_F = 50$ mA
V_{F4}	Forward Voltage	0.66	0.74	Volts	$I_F = 10$ mA
V_{F5}	Forward Voltage	0.54	0.62	Volts	$I_F = 1$ mA
I_{R1}	Reverse Current		0.1	μA	$V_R = -50$ V
I_{R2}	Reverse Current (150°C)		100	μA	$V_R = -50$ V
BV	Breakdown Voltage	75		Volts	$I_R = 5$ μA
t_{rr1}	Reverse Recovery Time (Note 2)		4.0	ns	$I_F = I_R =$ 10-200 mA
t_{rr2}	Reverse Recovery Time (Note 2)		6.0	ns	$I_F = I_R =$ 200-400 mA
C	Capacitance (Note 3)		2.5	pF	$V_R = 0$ V, f = 1 MHz

*Planar is a patented Fairchild process.

RADIATION TOLERANCE (See Notes on Back Page)

Radiation Threshold		1.0×10^{15} nvt	$V_F \leqq 1.0$ V at $I_F = 200$ mA $I_R \leqq 0.1$ μA at $V_R = -50$ V
End of Life Dosage	(a)	1.0×10^{15} nvt (at $\geqq$ 10 KeV)	$V_F \leqq 1.0$ V at $I_F = 200$ mA $I_R \leqq 0.1$ μA at $V_R = -50$ V
	(b)	5.0×10^{16} evt (at $\geqq$ 2.0 MeV)	$V_F \leqq 1.0$ V at $I_F = 200$ mA $I_R \leqq 0.1$ μA at $V_R = -50$ V

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SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

RADIATION RESISTANT SILICON PLANAR DIODE FDR600

…s

…maximum ratings are limiting values above which life or satisfactory performance may be impaired.
…ry to 0.1 I_F. $R_L = 100\ \Omega$.
…tance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
…ds are tinned. Gold plate with nickel strike may be obtained when specified.

…TIONS:

…on Threshold:	That radiation dosage above which the electrical parameters of a diode begin to change rapidly.
	A term defining an integrated dosage of neutron radiation. The number of neutrons per cm² with some average velocity for some time period.
	A term defining an integrated dosage of electron radiation. The number of electrons per cm² with some average velocity for some time period.
…r KeV:	Terms defining the energy level per bombarding particle: MeV = one million electronvolts KeV = one thousand electronvolts

GENERAL EFFECT OF RADIATION ON DIODE PARAMETERS

PARAMETERS	EFFECT
Reverse Current	Increased
Breakdown Voltage	Increased
Reverse Recovery Time	Decreased
Capacitance	Decreased
Forward Voltage	Increased

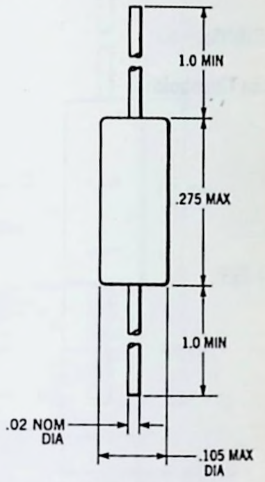
…e radiation effects can be removed by an annealing bake. For neutron radiation, temperatures of 250°C - 300°C are required; for electron radiation, temper…s greater than 150°C are required.

FDR700

RADIATION RESISTANT, PICOSECOND COMPUTER DIODE

GENERAL DESCRIPTION — The FDR700 is a silicon, planar*, epitaxial diode, specially designed to be radiation resistant. This high reliability device provides low capacitance, controlled forward conductance, and ultra fast reverse recovery time. It is ideally suited for applications such as nuclear propulsion systems, space satellite instrumentation, and nuclear weapons systems.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Weight: 0.25 gram.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	20 Volts
I_O	Average Rectified Current	50 mA
I_F	DC Forward Current	150 mA
i_f	Recurrent Peak Forward Current	150 mA
i_f(surge)	Peak Forward Surge Current Pulse Width = 1 sec.	250 mA
P	Power Dissipation	250 mW
$1/\theta$	Power Derating Factor	2 mW/°C
T_A	Operating Temperature	−65°C to +150°C
T_{stg}	Storage Temperature	−65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C Unless Otherwise Noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS
V_{F1}	Forward Voltage	.89	1.10	Volts	$I_F = 50$ mA
V_{F2}	Forward Voltage	.81	.95	Volts	$I_F = 20$ mA
V_{F3}	Forward Voltage	.76	.88	Volts	$I_F = 10$ mA
V_{F4}	Forward Voltage	.64	.74	Volts	$I_F = 1$ mA
V_{F5}	Forward Voltage	.52	.61	Volts	$I_F = 0.1$ mA
V_{F6}	Forward Voltage	.42	.50	Volts	$I_F = 0.01$/mA
BV	Breakdown Voltage	30		Volts	$I_R = 5\ \mu A$
I_{R1}	Reverse Current		50	nA	$V_R = 20$ V
I_{R2}	Reverse Current (150°C)		50	μA	$V_R = 20$ V
τ	Minority Carrier Lifetime		450	ps	See Note 2
t_{rr}	Reverse Recovery Time (Note 3)		700	ps	$I_F = I_R = 10$ mA RL = 100 Ω
C	Capacitance (Note 4)		.75	pF	$V_R = 0$ V, f = 1 MHz

*Planar is a patented Fairchild proc

RADIATION TOLERANCE (See Notes on Back Page.)

Radiation Threshold	1.0×10^{15} nvt	$V_F \leqq 1.1$ V at $I_F = 50$ mA $I_R \leqq 50$ nA at $V_R = -10$V
End of Life Dosage	1.0×10^{15} nvt (at $\geqq$ 10 KeV)	$V_F \leqq 1.1$ V at $I_F = 50$ mA $I_R \leqq 50$ nA at $V_R = -10$V
	5.0×10^{16} evt (at $\geqq$ 2.0 MeV)	$V_F \leqq 1.1$ V at $I_F = 50$ mA $I_R \leqq 50$ nA at $V_R = -10$V

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

RADIATION RESISTANT SILICON PLANAR DIODE FDR700

TES:

These maximum ratings are limiting values above which life or satisfactory performance may be impaired.
Measured as suggested by S. M. Krakauer, IRE Proceedings, Volume 60, July 1962, pp. 1674-1675.
Recovery to 0.1 I_F.
Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 Capacitance Bridge or equivalent.
Leads are tinned. Gold plate with nickel strike may be obtained when specified.

INITIONS:

iation Threshold:	That radiation dosage above which the electrical parameters of a diode begin to change rapidly.
	A term defining an integrated dosage of neutron radiation. The number of neutrons per cm² with some average velocity for some time period.
	A term defining an integrated dosage of electron radiation. The number of electrons per cm² with some average velocity for some time period.
or KeV:	Terms defining the energy level per bombarding particle: MeV = one million electronvolts KeV = one thousand electronvolts

GENERAL EFFECT OF RADIATION ON DIODE PARAMETERS

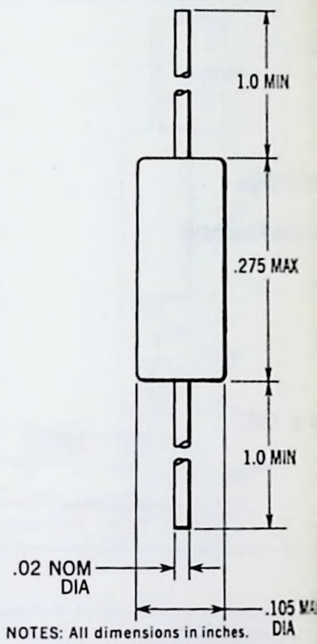
PARAMETERS	EFFECT
Reverse Current	Increased
Breakdown Voltage	Increased
Reverse Recovery Time	Decreased
Capacitance	Decreased
Forward Voltage	Increased

radiation effects can be removed by an annealing bake. For neutron radiation, temperatures of 250°C - 300°C are required; for electron radiation, temper-
s greater than 150°C are required.

FH1100
HOT CARRIER DIODE

GENERAL DESCRIPTION — The Fairchild FH1100 Hot Carrier Diode features low leakage, high conductance and low noise figure. It is intended primarily for use as the mixer diode in UHF tuners. Its outstanding switching properties make it also ideal for use in ultra-fast switching, detector, and sampling gate applications.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Weight: 0.25 gram.

MAXIMUM RATINGS

P	Power Dissipation ($T_A = 25°C$)	100 mW
T_A	Operating Temperature	−55°C to +125°C
T_{stg}	Storage Temperature	−55°C to +150°C

ELECTRICAL SPECIFICATIONS

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
V_F	Forward Voltage			0.55	V	$I_F = 10$ mA
I_R	Leakage Current		50		nA	$V_R = 1$ V $T_A = 25°C$
BV	Breakdown Voltage	5			V	$I_R = 100\ \mu A$
C_o	Capacitance		0.85	1.0	pF	$V_R = 0$ V, f = 1 MHz
NF	Noise Figure			10	dB	f = 890 MHz See Page 2
Q_s	Stored Charge [Note 1]		1.6		pC	$I_F = 10$ mA

Note 1 — Measured on B-Line Electronics QS-3 Stored Charge Meter.

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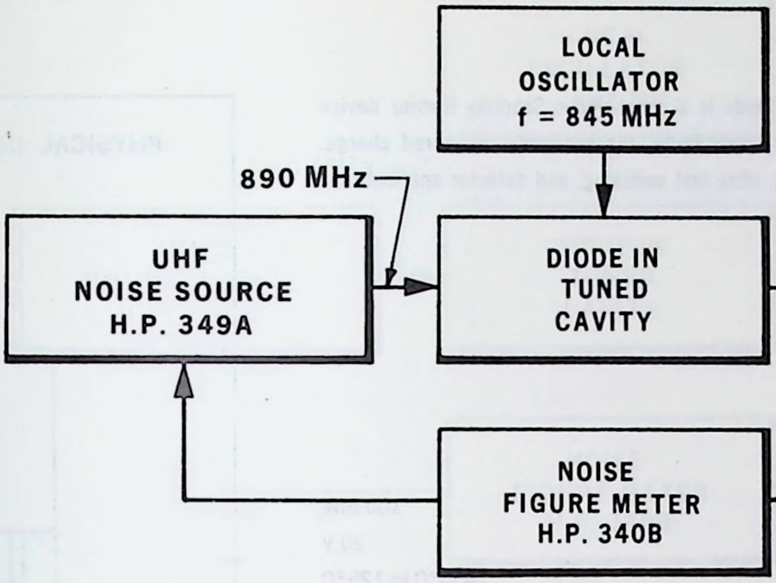
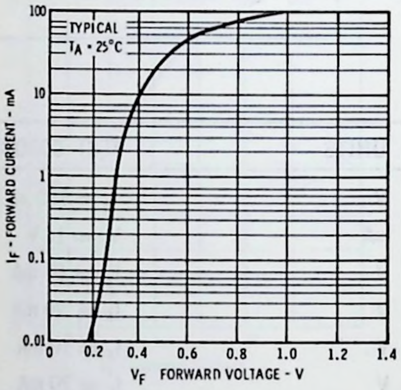
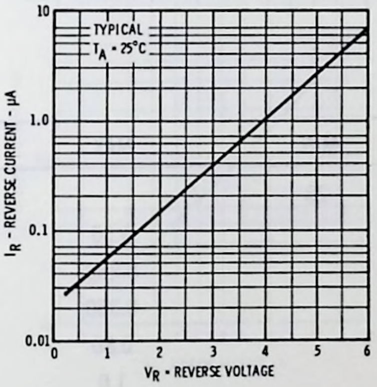

LOCAL
OSCILLATOR
f = 845 MHz
890 MHz
UHF
NOISE SOURCE
H.P. 349A
DIODE IN
TUNED
CAVITY
45 MHz
IF AMPLIFIER
NF = 2.0db
NOISE
FIGURE METER
H.P. 340B

NOISE FIGURE TEST CIRCUIT

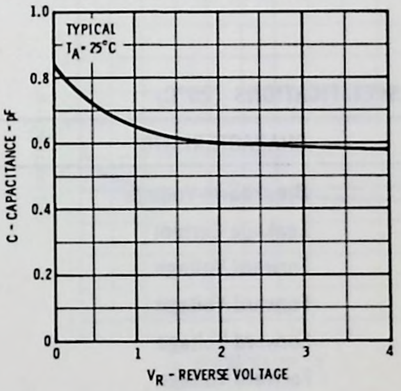
FORWARD CURRENT VERSUS FORWARD VOLTAGE



REVERSE CURRENT VERSUS REVERSE VOLTAGE



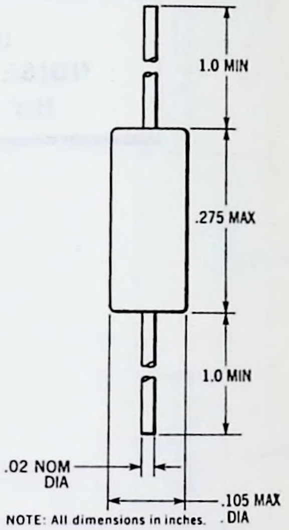
CAPACITANCE VERSUS REVERSE VOLTAGE



FH1200
HIGH VOLTAGE HOT CARRIER DIODE

GENERAL DESCRIPTION — The Fairchild FH1200 Hot Carrier Diode is a metal-silicon Schottky Barrier device which features high breakdown voltage, low capacitance, low noise figure, and extremely-low stored charge. Its outstanding characteristics make it ideal for use in mixing, ultra fast switching, and detector applications.

PHYSICAL DIMENSIONS



NOTE: All dimensions in inches.

MAXIMUM RATINGS

P	Power Dissipation (25°C)	100 mW
WIV	Working Inverse Voltage	20 V
T_A	Operating Temperature	−55°C to 125°C
T_{STG}	Storage Temperature	−55°C to 150°C

ELECTRICAL SPECIFICATIONS (25°C)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
B_V	Breakdown Voltage	25		V	$I_R = 100\ \mu A$
I_R	Leakage Current		0.50	μA	$V_R = 10$ V
V_{F1}	Forward Voltage		0.250	V	$I_F = .01$ mA
V_{F2}	Forward Voltage		0.350	V	$I_F = .20$ mA
V_{F3}	Forward Voltage		0.80	V	$I_F = 10$ mA
V_{F4}	Forward Voltage		1.0	V	$I_F = 20$ mA
C	Capacitance		0.80	pf	$V_R = 0$ V
NF	Noise Figure		10	dB	f = 890 MHz See Page 2
Q_S*	Stored Charge		2.0	pC	$I_F = 10$ mA

*Measured on B-Line Electronics QS-3 Stored Charge Meter

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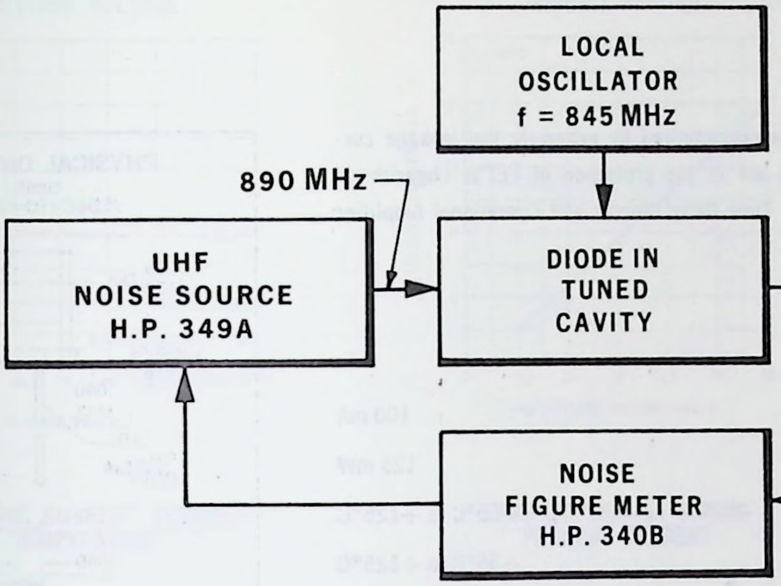
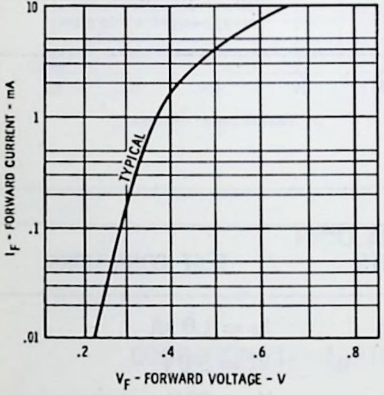
FAIRCHILD DIODE FH1200

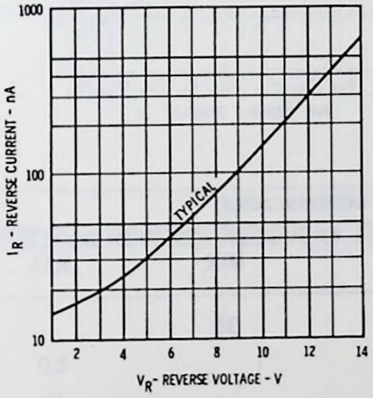
NOISE FIGURE TEST CIRCUIT


LOCAL OSCILLATOR f = 845 MHz
890 MHz
UHF NOISE SOURCE H.P. 349A
DIODE IN TUNED CAVITY
45 MHz IF AMPLIFIER NF = 2.0db
NOISE FIGURE METER H.P. 340B

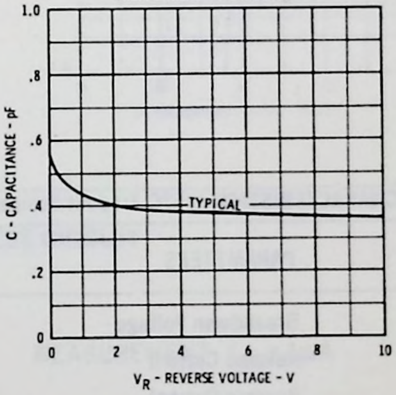
FORWARD CURRENT VERSUS FORWARD VOLTAGE



REVERSE CURRENT VERSUS REVERSE VOLTAGE



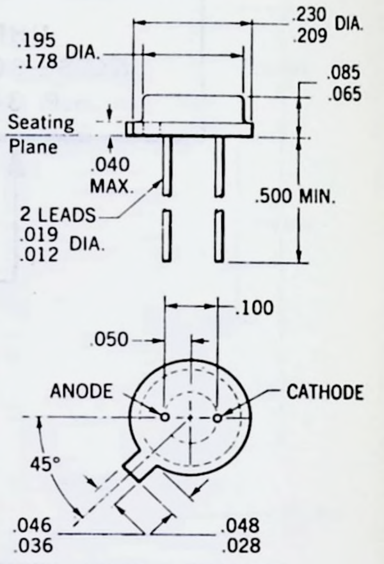
CAPACITANCE VERSUS REVERSE VOLTAGE



FJT1000
SILICON PLANAR* PICO AMPERE DIODE

GENERAL DESCRIPTION — The Fairchild Pico Ampere Diode is characterized by extremely low leakage currents over a wide temperature range. Principal applications are in the protection of FET's; Logarithmic Generators; Sample and Hold Circuits; Peak Follower Circuits; Time Delay Circuits and Operational Amplifier Clamping.

PHYSICAL DIMENSIONS
similar to
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Cathode connected to case
Package weight is 0.36 gram

MAXIMUM RATINGS (Note 1)

I_F	Forward Current	100 mA
P	Power Dissipation	125 mW
T_o	Operating Temperature	−55°C to +125°C
T_{stg}	Storage Temperature	−55°C to +125°C
I_Z	Zener Current	2.0 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	PARAMETERS	MIN.	MAX.	UNITS	TEST CONDITIONS	
BV	Breakdown Voltage	35		Volts	$I_R = 1.0\ \mu A$	
I_R	Reverse Current		5.0	pA	$V_R = 5.0\ V$	
I_R	Reverse Current		10	pA	$V_R = 20\ V$	
I_R	Reverse Current		500	pA	$V_R = 5.0\ V$	$T_A = 80°C$
V_F	Forward Voltage		1.0	Volts	$I_F = 10\ mA$	
C	Capacitance		1.3	pF	$V_R = 0\ V$	f = 1.0 MHz
t_{rr}	Reverse Recovery Time		250	ns	$I_F = I_R = 10\ mA$	$I_{RR} = 1.0\ mA$

*Planar is a patented Fairchild proces

NOTES:
(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

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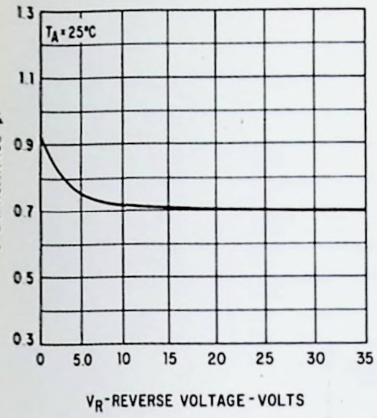
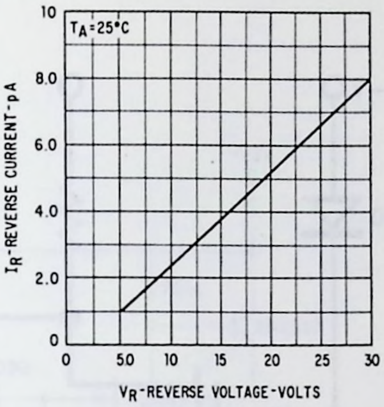
FAIRCHILD PICO AMPERE DIODE FJT1000

TYPICAL ELECTRICAL CHARACTERISTICS

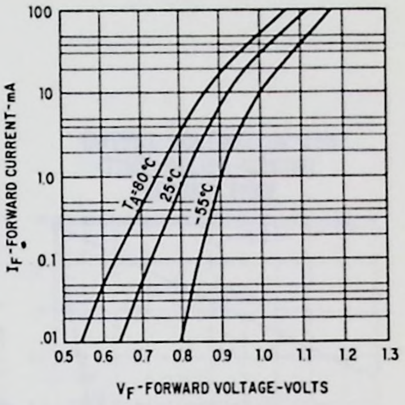
CAPACITANCE VERSUS REVERSE VOLTAGE



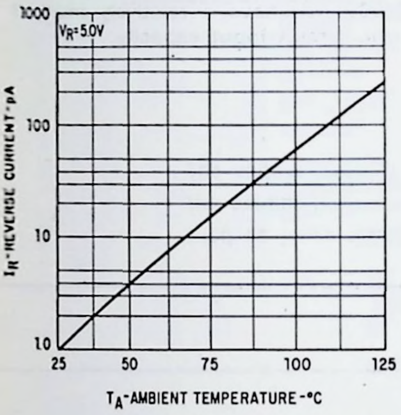
REVERSE CURRENT VERSUS REVERSE VOLTAGE



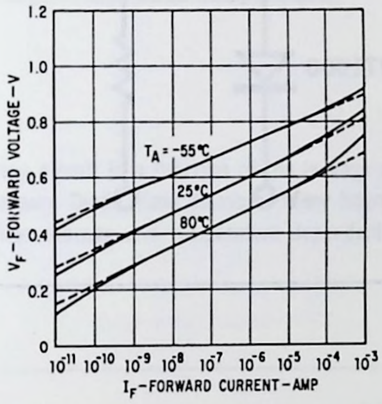
FORWARD CURRENT VERSUS FORWARD VOLTAGE



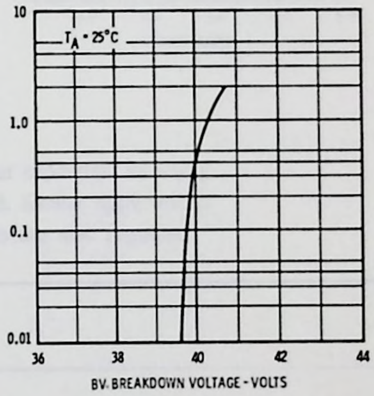
REVERSE CURRENT VERSUS TEMPERATURE



FORWARD VOLTAGE VERSUS FORWARD CURRENT



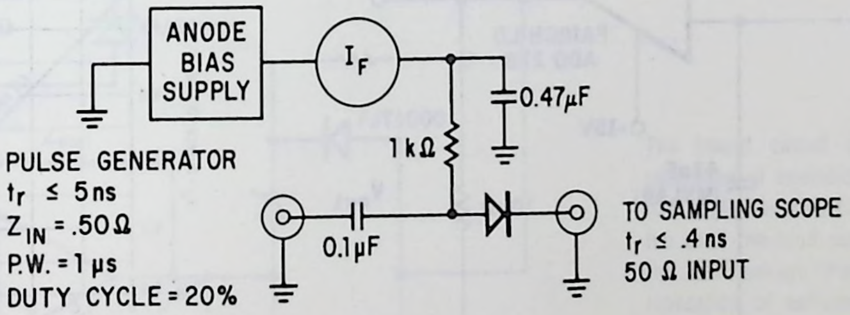
TYPICAL CURRENT VOLTAGE CHARACTERISTICS IN THE BREAKDOWN REGION



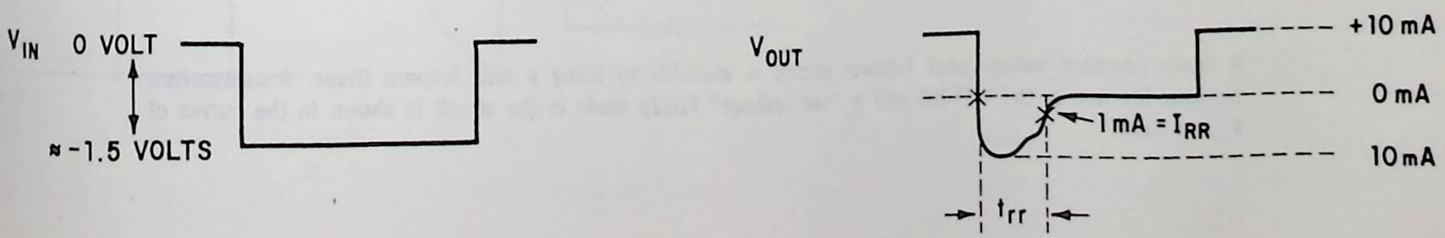
PICO AMP DIODE FJT1000 REVERSE RECOVERY TIME (t_{rr}) TEST CIRCUIT

CONDITION: $I_F = I_R = 10$ mA

MEASUREMENT $I_{RR} = 1mA$



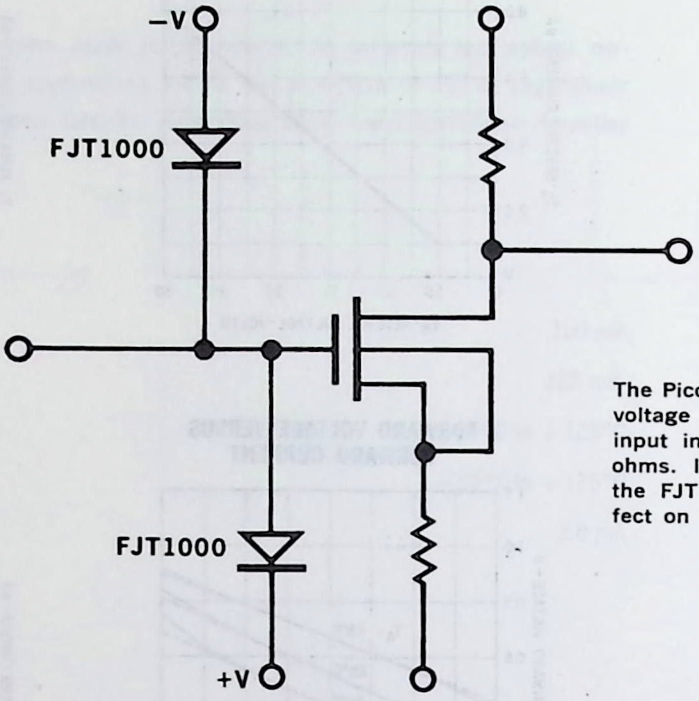
ANODE BIAS SUPPLY
I_F
0.47µF
1kΩ
PULSE GENERATOR
$t_r \leq 5ns$
$Z_{IN} = 50\Omega$
P.W. = 1µs
DUTY CYCLE = 20%
0.1µF
TO SAMPLING SCOPE
$t_r \leq .4$ ns
50 Ω INPUT



V_{IN}
0 VOLT
≈ -1.5 VOLTS
V_{OUT}
+10 mA
0 mA
1 mA = I_{RR}
10 mA
t_{rr}

FAIRCHILD PICO AMPERE DIODE FJT1000

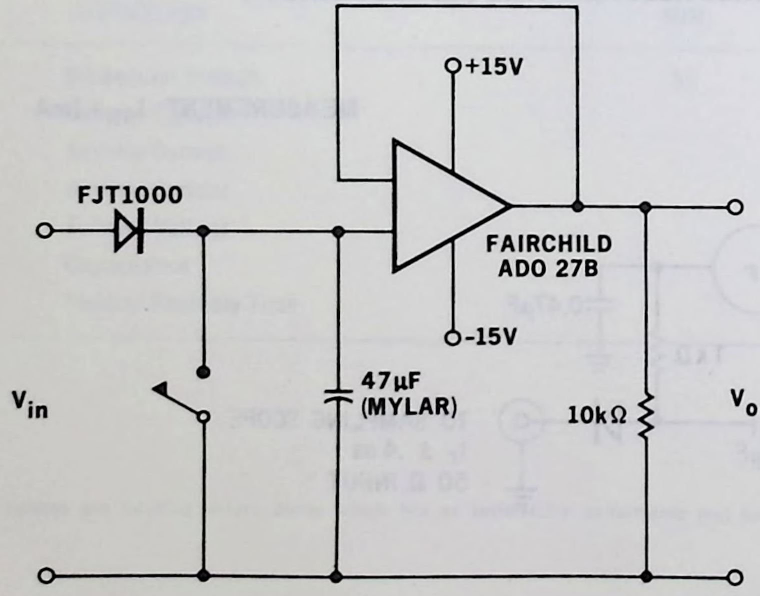
MOS FET PROTECTION CIRCUIT



−V
FJT1000
FJT1000
+V

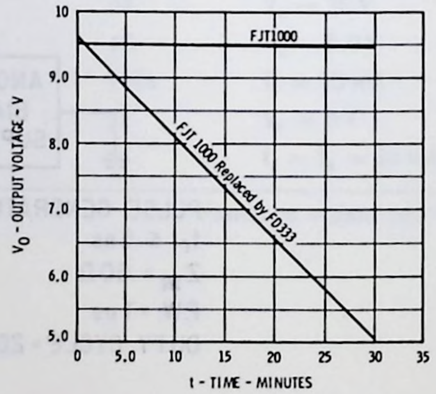
The Pico Ampere Diode affords excellent gate voltage protection while maintaining the DC input impedance at about one million megohms. In addition the very low capacity of the FJT1000 will have a relatively small effect on the circuit input capacity.

PEAK FOLLOWER CIRCUIT



+15V
FJT1000
FAIRCHILD
ADO 27B
-15V
47µF
(MYLAR)
V_{in}
10kΩ
V_{out}

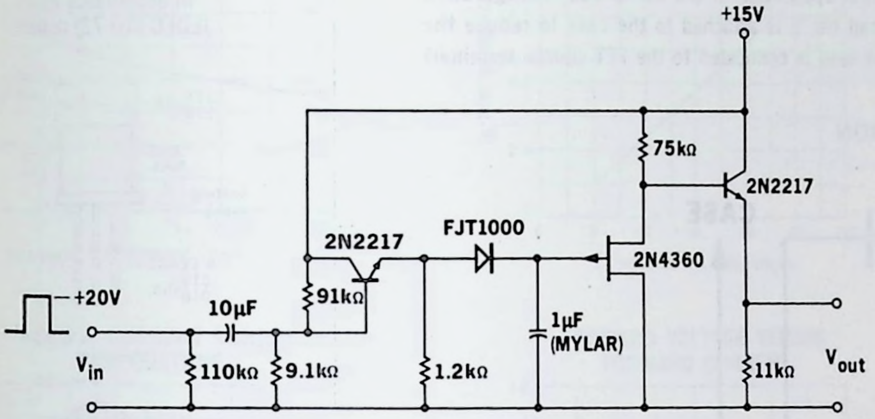
OUTPUT VOLTAGE OF THE PEAK FOLLOWER CIRCUIT VERSUS TIME



A nearly constant voltage peak follower circuit is available by using a Pico Ampere Diode. A comparison between the use of the FJT1000 and a "low leakage" FD333 diode in the circuit is shown in the curves of V_{out} vs Time.

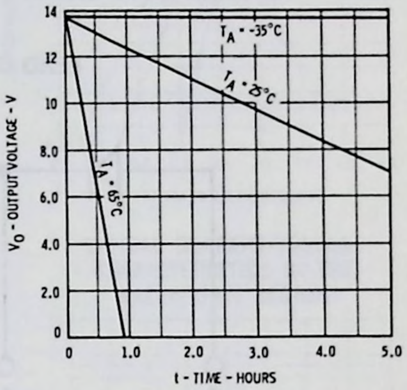
FAIRCHILD PICO AMPERE DIODE FJT1000

TIME DELAY CIRCUIT



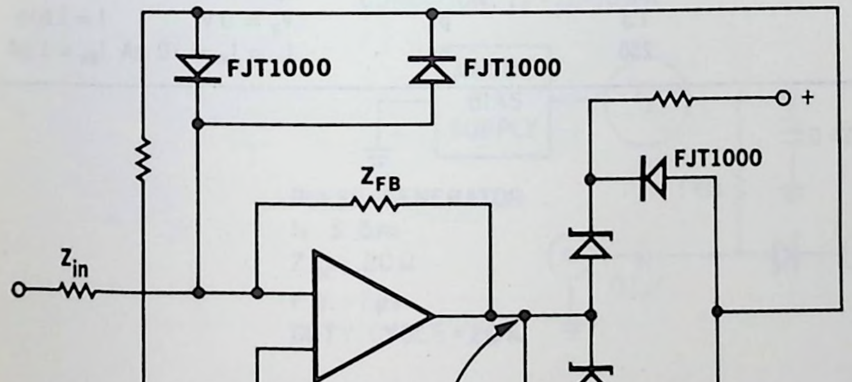
+15V
75kΩ
2N2217
FJT1000
2N2217
2N4360
+20V
10μF
91kΩ
1μF
(MYLAR)
V_{in}
110kΩ
9.1kΩ
1.2kΩ
11kΩ
V_{out}

OUTPUT VOLTAGE OF THE TIME DELAY CIRCUIT VERSUS TIME



The voltage decay of the time delay circuit is a function of the leakage across the mylar capacitor. By using the extremely low leakage Pico Ampere Diode, time delays of many hours are measured. Similar applications such as pulse stretching, finite time storage and temperature dependent timing circuits are also feasible.

A BOUND CIRCUIT FOR OPERATIONAL AMPLIFIERS



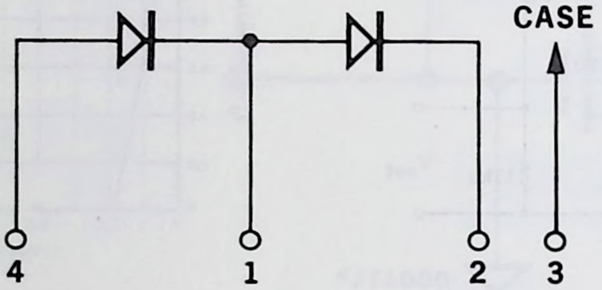
FJT1000
FJT1000
Z_{FB}
+
FJT1000
Z_{in}
V_{in}
V_{out}
R_L
FJT1000
-

The bound circuit prevents overloading and saturation of operational amplifiers. The circuit has negligible effect on the operational amplifier until overload conditions occur. The use of the low leakage Pico Ampere Diode permits realization of extremely high input impedance for normal input voltages.

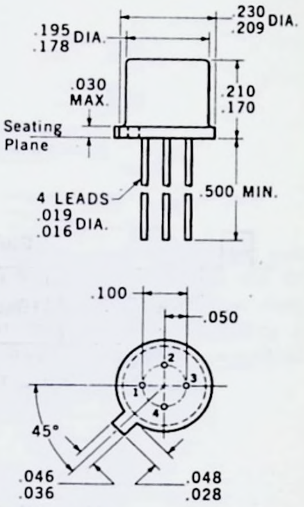
FJT2000
DUAL PICO AMPERE DIODE

GENERAL DESCRIPTION — The Fairchild Dual Pico Ampere Diode is a silicon Planar* epitaxial diode characterized by extremely low reverse leakage currents. The principal application of the series dual configuration is in extremely high impedance protection circuits for FETs. Lead No. 3 is attached to the case to reduce the input capacitance in FET source follower applications. (The case lead is connected to the FET source terminal)

LEAD CONNECTION



PHYSICAL DIMENSONS
in accordance with
JEDEC (TO-72) outline



NOTES: All dimensions in inches
Dimensions similar to JEDEC TO-18 except 4 leads 90° spacing
Leads are gold-plated kovar
Package weight is 0.36 gram

MAXIMUM RATINGS EACH JUNCTION (25°C)

I_F	Forward Current	100 mA
P	Power Dissipation*	125 mW
T_A	Operating Temperature	−55°C to +125°C
T_{stg}	Storage Temperature	−55°C to +125°C

*Rating, for both diode junctions conducting simultaneously, is 80 mW maximum per junction.

ELECTRICAL CHARACTERISTICS EACH JUNCTION (25°C unless otherwise noted)

SYMBOL	PARAMETERS	MIN.	MAX.	UNITS	TEST CONDITIONS	
BV	Breakdown Voltage	35		Volts	$I_R = 1.0\ \mu A$	
I_R	Reverse Current		5	pA	$V_R = 5$ V	
I_R	Reverse Current		10	pA	$V_R = 20$ V	
I_R	Reverse Current		500	pA	$V_R = 5$ V	$T_A = 80°C$
V_F	Forward Voltage		1.0	Volts	$I_F = 10$ mA	
C	Capacitance		1.3	pF	$V_R = 0$ V	f = 1 MHz
t_{rr}	Reverse Recovery Time		250	ns.	$I_F = I_R = 10$ mA	$I_{RR} = 1$ mA

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*Planar is a patented Fairchild process.

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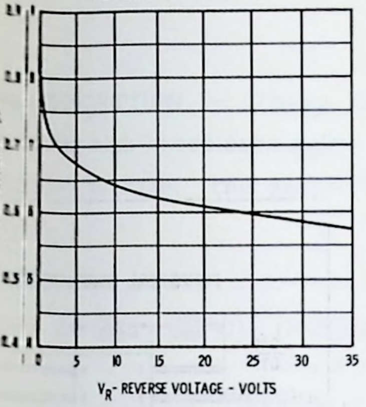
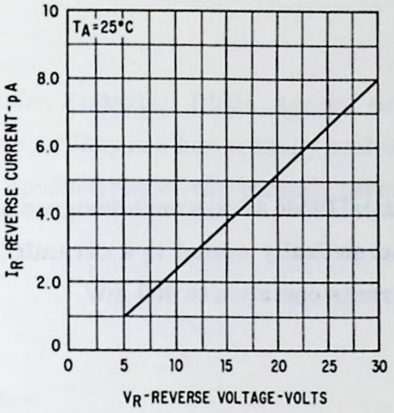
FAIRCHILD DIODE FJT2000

TYPICAL ELECTRICAL CHARACTERISTICS EACH JUNCTION (25°C)

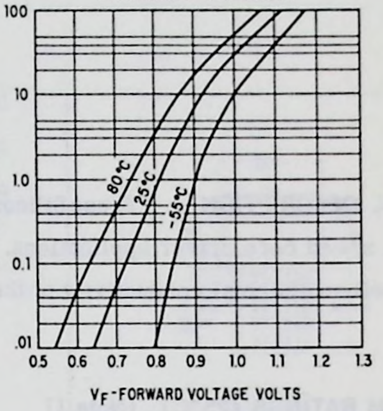
CAPACITANCE VERSUS REVERSE VOLTAGE



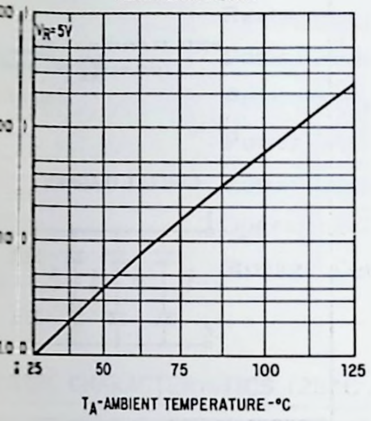
REVERSE CURRENT VERSUS REVERSE VOLTAGE



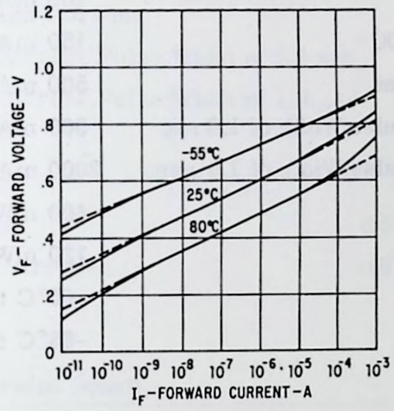
FORWARD CURRENT VERSUS FORWARD VOLTAGE



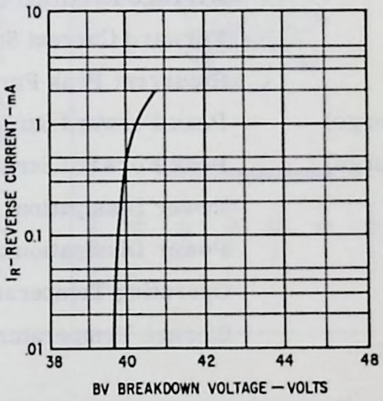
REVERSE CURRENT VERSUS TEMPERATURE



FORWARD VOLTAGE VERSUS FORWARD CURRENT



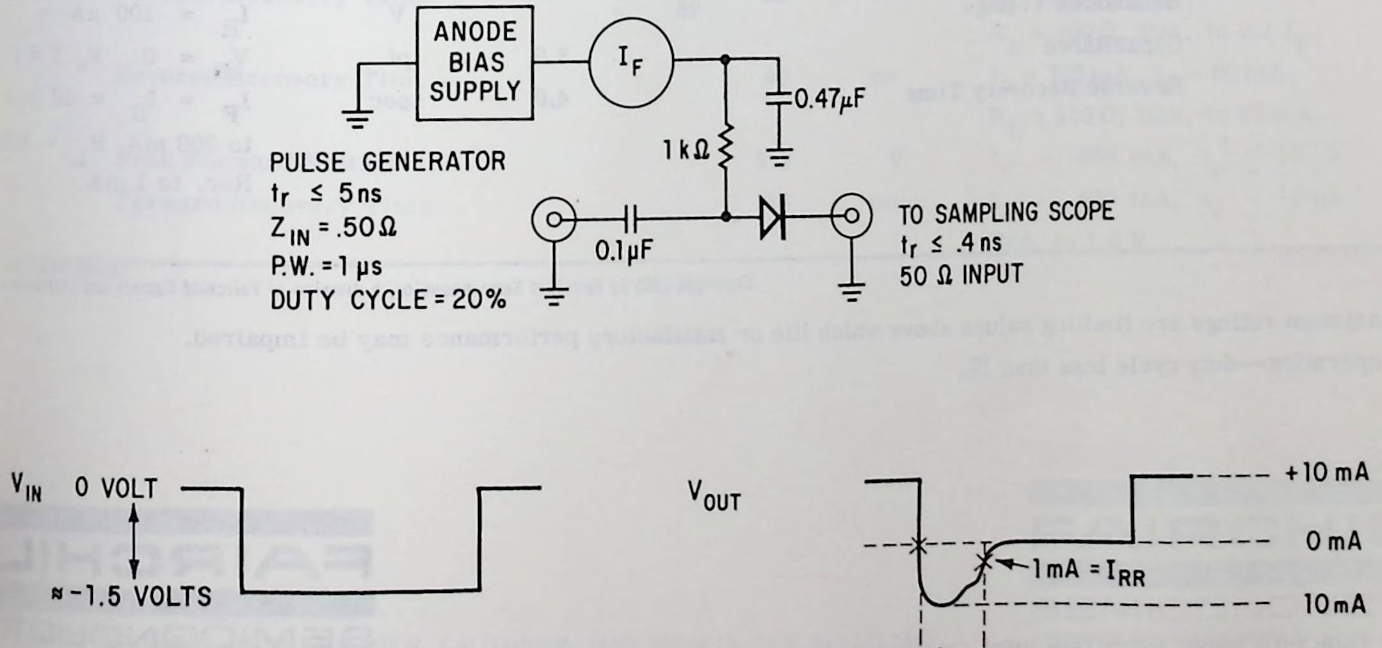
TYPICAL CURRENT-VOLTAGE CHARACTERISTICS IN THE BREAKDOWN REGION



PICO AMP DIODE FJT2000 REVERSE RECOVERY TIME (t_{rr}) TEST CIRCUIT

CONDITION: $I_F = I_R = 10$ mA

MEASUREMENT $I_{RR} = 1$mA



ANODE BIAS SUPPLY
I_F
0.47μF
1kΩ
0.1μF
PULSE GENERATOR
$t_r \leq 5$ns
$Z_{IN} = .50\Omega$
P.W. = 1 μs
DUTY CYCLE = 20%
TO SAMPLING SCOPE
$t_r \leq .4$ ns
50 Ω INPUT
V_{IN}
0 VOLT
≈ -1.5 VOLTS
V_{OUT}
+10 mA
0 mA
$1\text{mA} = I_{RR}$
10 mA
t_{rr}

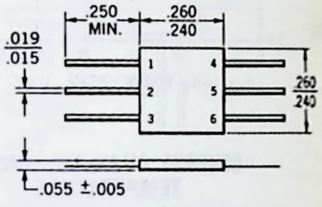
FSA1400

ULTRA FAST, EIGHT DIODE, CORE DRIVER ARRAY

SILICON PLANAR EPITAXIAL CONSTRUCTIO

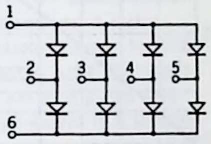
GENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed especially for high speed core driver applications. They are hermetically sealed in a ceramic package. The excellent thermal conductivity of the ceramic permits operation to 400 mW.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are $\frac{.0060}{.0035}$ thick kovar

CIRCUIT DIAGRAM



MAXIMUM RATINGS (25°C) [Note 1]

WIV	Working Inverse Voltage	50 V
I_o	Average Rectified Current	100 mA
I_F	Forward Current Steady State DC	150 mA
i_f	Recurrent Peak Forward Current	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
P	Power Dissipation at 125°C	120 mW
T_A	Operating Temperature	-65°C to +175°C
T_{stg}	Storage Temperature, Ambient	-65°C to +200°C

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{F1}	Forward Voltage		1.30	V	I_F = 500 mA (Note 2)
V_{F2}	Forward Voltage		1.0	V	I_F = 200 mA
V_{F3}	Forward Voltage		0.860	V	I_F = 50 mA
I_R	Reverse Current		100	nA	V_R = -50 V
BV	Breakdown Voltage	75		V	I_R = 100 μA
C	Capacitance		3.0	pf	V_R = 0 V, f = 1 Mc
t_{rr}	Reverse Recovery Time		4.0	nsec	I_F = I_R = 10 mA to 200 mA, R_L = 100 Ω Rec. to 1 mA

NOTES:

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(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

(2) Pulse operation—duty cycle less than 1%.

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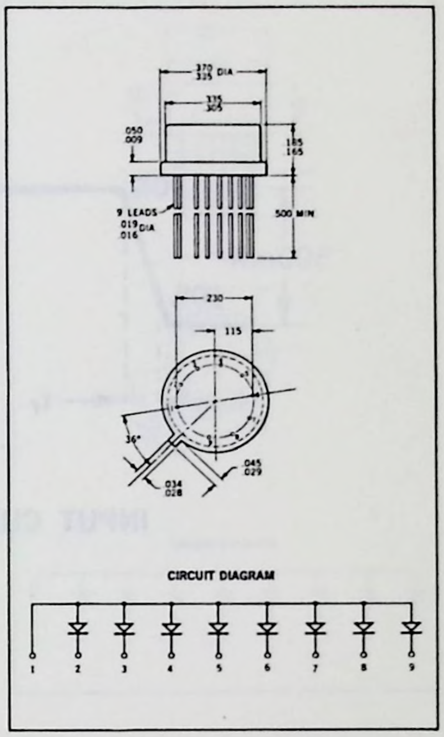
FSA1410

ULTRA FAST, EIGHT DIODE, COMMON-ANODE ARRAY

SILICON PLANAR EPITAXIAL CONSTRUCTION



GENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed especially for high-speed core driver applications. They are hermetically sealed in the basic 10 lead TO-5 package. The excellent thermal conductivity of the package permits operation to 4000 mW.

MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_O	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
$\frac{1}{\theta}$	Power Derating Factors	3.2 mW/°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

LECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

ymbol	Characteristic	Min.	Max.	Units	Test Conditions	
F1	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
F2	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
F3	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
V	Breakdown Voltage	60		V	I_R = 100 μA	
R1	Reverse Current		100	nA	V_R = -40 V	
R2	Reverse Current (T_A = 150°C)		100	μA	V_R = -40 V	
	Capacitance		7.0	pf	V_R = 0, f = 1 MHz	
r1	Reverse Recovery Time		25	ns	I_F = I_R = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
r2	Reverse Recovery Time		90	ns	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
FM	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq$ 10 ns	(Note 3)
r	Forward Recovery Time		40	ns	I_F = 500 mA, $t_r \leq$ 10 ns Rec. to 1.6 V	(Note 3)

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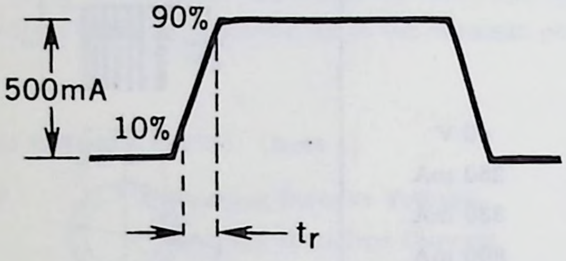
NOTES:

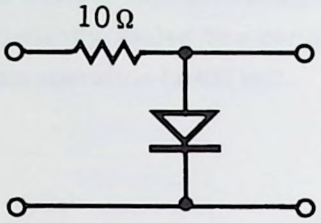
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

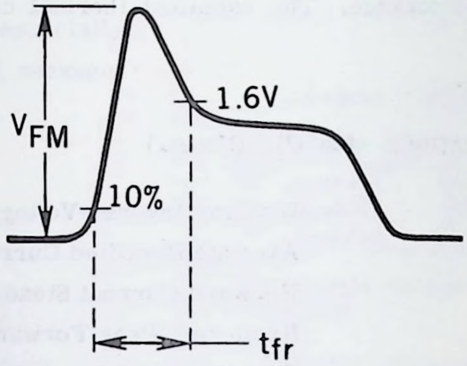
(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Test Circuit for V_{FM} and t_{fr} is as shown below:



INPUT CURRENT PULSE





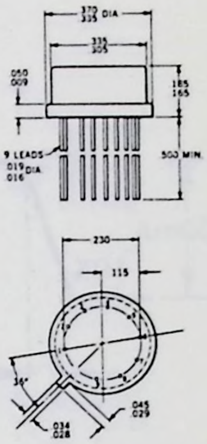
OUTPUT VOLTAGE PULSE

FSA1411

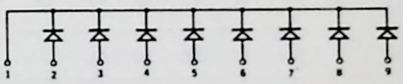
ULTRA FAST, EIGHT DIODE, COMMON-CATHODE ARRAY

SILICON PLANAR* EPITAXIAL CONSTRUCTION

ENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed pecially for high-speed core driver applications. They are hermetically sealed in the basic lead TO-5 package. The excellent thermal conductivity of the package permits operation 400 mW.



CIRCUIT DIAGRAM



AXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_o	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
$1/\theta$	Power Derating Factor	3.2 mW/°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{F1}	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
V_{F2}	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
V_{F3}	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
BV	Breakdown Voltage	60		V	I_R = 100 μA	
I_{R1}	Reverse Current		100	nA	V_R = -40 V	
I_{R2}	Reverse Current (T_A = 150°C)		100	μA	V_R = -40 V	
C	Capacitance		3.0	pf	V_R = 0, f = 1 MHz	
t_{rr1}	Reverse Recovery Time		25	ns	$I_F = I_R$ = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
t_{rr2}	Reverse Recovery Time		90	ns	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
V_{FM}	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq 10$ ns	(Note 3)
t_{fr}	Forward Recovery Time		40	ns	I_F = 500 mA, $t_r \leq 10$ ns Rec. to 1.6 V	(Note 3)

ee notes on back page)

* Planar is a patented Fairchild process.

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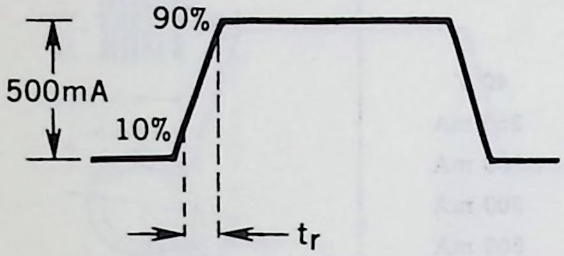
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

NOTES:

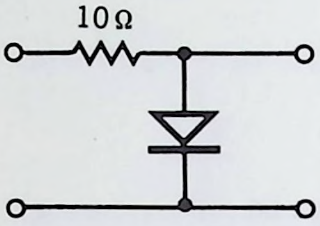
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

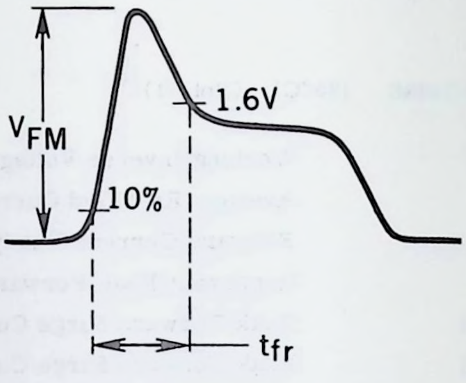
(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Test Circuit for V_{FM} and t_{fr} is as shown below:



INPUT CURRENT PULSE





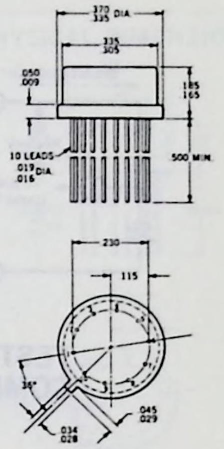
OUTPUT VOLTAGE PULSE

FSA1412

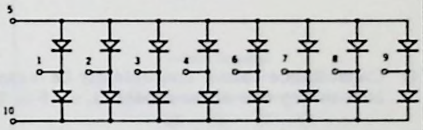
ULTRA FAST, SIXTEEN DIODE, CORE DRIVER ARRAY

SILICON PLANAR* EPITAXIAL CONSTRUCTION

GENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed especially for high-speed core driver applications. They are hermetically sealed in the basic 10 lead TO-5 package. The excellent thermal conductivity of the package permits operation to 400 mW.



CIRCUIT DIAGRAM



MAXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_o	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
$1/\theta$	Power Derating Factor	3.2 mW/°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ELECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{F1}	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
V_{F2}	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
V_{F3}	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
BV	Breakdown Voltage	60		V	I_R = 100 μA	
I_{R1}	Reverse Current		100	nA	V_R = -40 V	(Note 3)
I_{R2}	Reverse Current		100	μA	V_R = -40 V	(Note 3)
C	Capacitance		8.0	pf	V_R = 0, f = 1 mc	(Note 4)
t_{rr1}	Reverse Recovery Time		25	ns	$I_F = I_R$ = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
t_{rr2}	Reverse Recovery Time		90	ns	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
V_{FM}	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq$ 10 ns	(Note 5)
t_{fr}	Forward Recovery Time		40	ns	I_F = 500 mA, $t_r \leq$ 10 ns Rec. to 1.6 V	(Note 5)

(See notes on back page)

* Planar is a patented Fairchild process.

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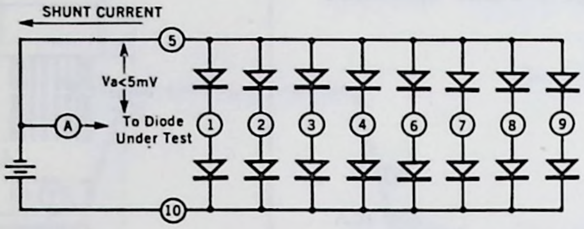
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

NOTES:

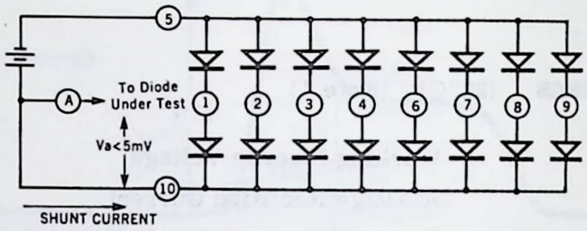
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Reverse current measurements between terminals result in substantial leakage contributions from other diodes in the array. To measure diodes individually (specification limit is for individual diodes), current may be shunted by employing following test configuration.


SHUNT CURRENT
5
Va<5mV
A
To Diode Under Test
1
2
3
4
6
7
8
9
10

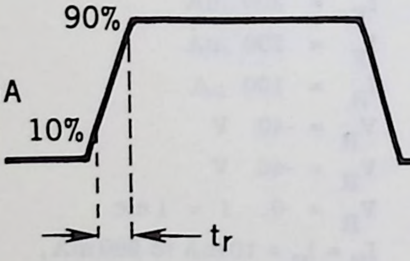
TEST CONNECTIONS FOR COMMON-CATHODE DIODES


5
A
To Diode Under Test
1
2
3
4
6
7
8
9
Va<5mV
10
SHUNT CURRENT

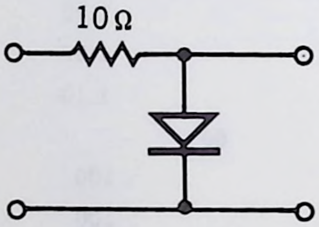
TEST CONNECTIONS FOR COMMON-ANODE DIODES

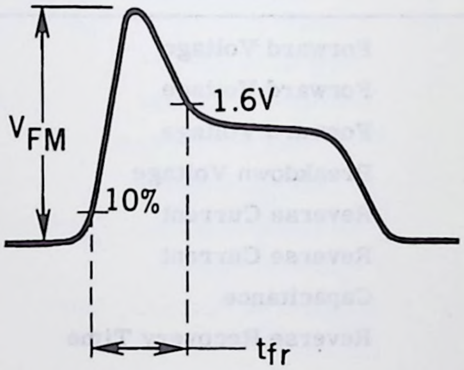
(4) Capacitance cannot conveniently be measured on individual diodes due to contributions of other diodes in the array. Limit listed is for pin-to-pin capacitance across any one of the diodes (i. e., 5 to 1, 5 to 2, etc. or 10 to 1, 10 to 2, etc.)

(5) Test Circuit for V_{FM} and t_{fr} is as shown below:


90%
500mA
10%
t_r

INPUT CURRENT PULSE




V_{FM}
1.6V
10%
t_{fr}

OUTPUT VOLTAGE PULSE

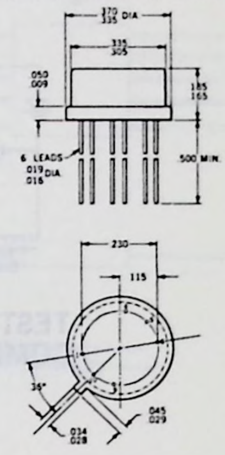
FSA1413

ULTRA FAST, EIGHT DIODE, CORE DRIVER ARRAY

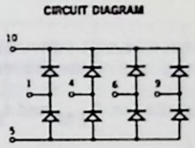
SILICON PLANAR EPITAXIAL CONSTRUCTION

ENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed especially for high-speed core driver applications. They are hermetically sealed in the basic 10 lead TO-5 package. The excellent thermal conductivity of the package permits operation o 400 mW.

PHYSICAL DIMENSIONS



CIRCUIT DIAGRAM



AXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_o	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
P	Power Dissipation at 125°C	120 mW
T_A	Operating Temperature	-65°C to +175°C
T_{stg}	Storage Temperature, Ambient	-65°C to +200°C

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{F1}	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
V_{F2}	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
V_{F3}	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
BV	Breakdown Voltage	60		V	I_R = 100 μA	
I_{R1}	Reverse Current		100	nA	V_R = -40 V	(Note 3)
I_{R2}	Reverse Current		100	μA	V_R = -40 V	(Note 3)
C	Capacitance		8.0	pf	V_R = 0, f = 1 Mc	(Note 4)
t_{rr1}	Reverse Recovery Time		25	nsec	$I_F = I_R$ = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
t_{rr2}	Reverse Recovery Time		90	nsec	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
V_{FM}	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq$ 10 nsec	(Note 5)
t_{fr}	Forward Recovery Time		40	nsec	I_F = 500 mA, $t_r \leq$ 10 nsec, Rec. to 1.6 V	(Note 5)

notes on back page)

FAIRCHILD
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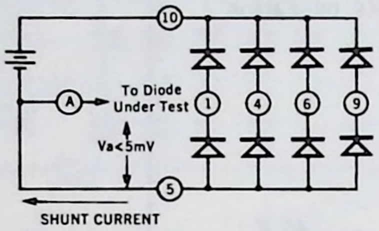
NOTES:

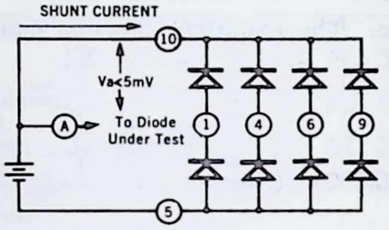
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Reverse current measurements between terminals result in substantial leakage contributions from other diodes in the array. To measure diodes individually (specification limit is for individual diodes), current may be shunted by employing following test configuration.


10
A
To Diode Under Test
1
4
6
9
Va<5mV
5
SHUNT CURRENT

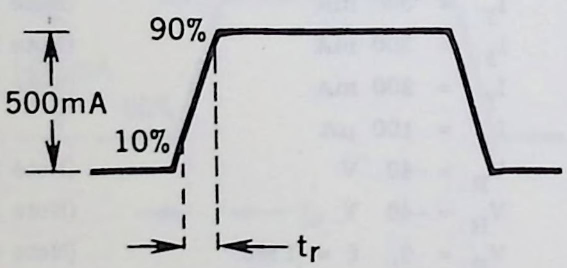
TEST CONNECTIONS FOR COMMON-CATHODE DIODES


SHUNT CURRENT
10
Va<5mV
A
To Diode Under Test
1
4
6
9
5

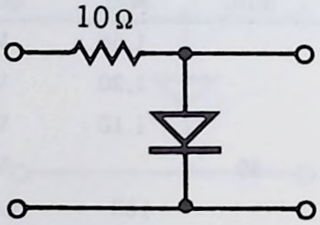
TEST CONNECTIONS FOR COMMON-ANODE DIODES

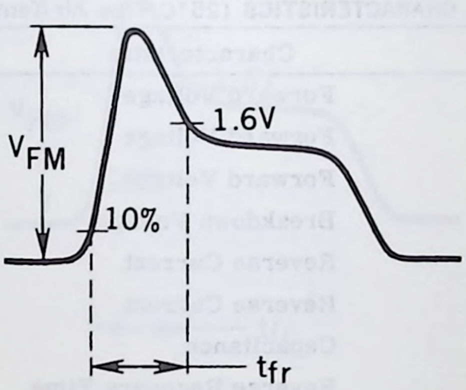
(4) Capacitance cannot conveniently be measured on individual diodes due to contributions of other diodes in the array. Limit listed is for pin-to-pin capacitance across any one of the diodes (i. e., 5 to 1, 10 to 6, etc.)

(5) Test Circuit for V_{FM} and t_{fr} is as shown below:


90%
500mA
10%
t_r

INPUT CURRENT PULSE




1.6V
V_{FM}
10%
t_{fr}

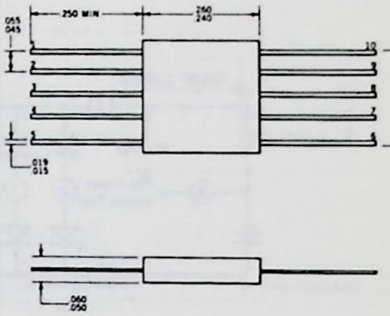
OUTPUT VOLTAGE PULSE

FSA2000

ULTRA FAST, SIXTEEN DIODE, CORE DRIVER ARRAY

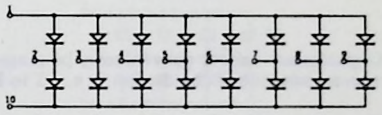
SILICON PLANAR EPITAXIAL CONSTRUCTION

ENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed pecially for high-speed core driver applications. They are hermetically sealed in a ceramic ckage. The excellent thermal conductivity of the ceramic permits operation to 400 mW.



NOTES: All dimensions in inches
Leads are $\frac{.0065}{.0035}$ thick kovar

CIRCUIT DIAGRAM



XIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_o	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
P	Power Dissipation at 125°C	120 mW
T_A	Operating Temperature	-65°C to +175°C
T_{stg}	Storage Temperature, Ambient	-65°C to +200°C

CTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

mbol	Characteristic	Min.	Max.	Units	Test Conditions	
1	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
2	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
3	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
	Breakdown Voltage	60		V	I_R = 100 μA	
1	Reverse Current		100	nA	V_R = -40 V	(Note 3)
2	Reverse Current (T_A = 150°C)		100	μA	V_R = -40 V	(Note 3)
	Capacitance		8.0	pf	V_R = 0, f = 1 Mc	(Note 4)
1	Reverse Recovery Time		25	nsec	$I_F = I_R$ = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
2	Reverse Recovery Time		90	nsec	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
M I	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq$ 10 nsec	(Note 5)
	Forward Recovery Time		40	nsec	I_F = 500 mA, $t_r \leq$ 10 nsec, Rec. to 1.6 V	(Note 5)

notes on back page)

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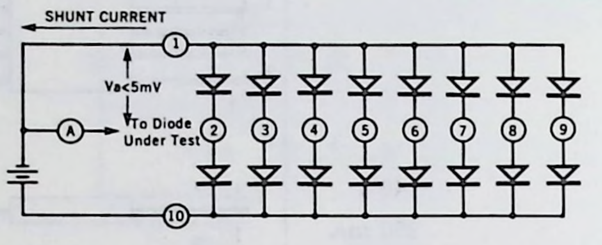
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

NOTES:

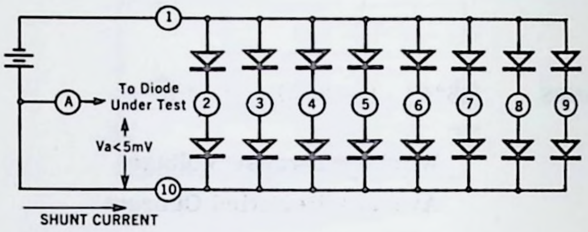
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Reverse current measurements between terminals result in substantial leakage contributions from other diodes in the array. To measure diodes individually (specification limit is for individual diodes), current may be shunted by employing following test configuration.


SHUNT CURRENT
Va<5mV
A
To Diode Under Test
1
2
3
4
5
6
7
8
9
10

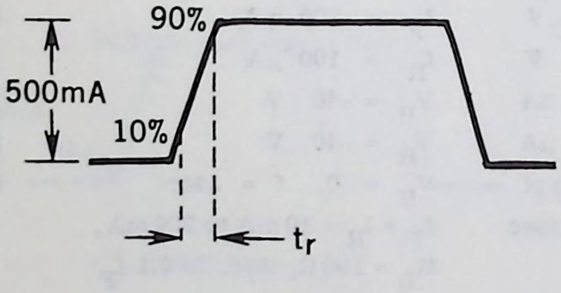
TEST CONNECTIONS FOR COMMON-CATHODE DIODES


1
A
To Diode Under Test
Va<5mV
2
3
4
5
6
7
8
9
10
SHUNT CURRENT

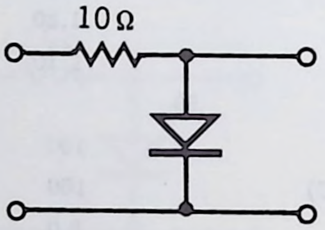
TEST CONNECTIONS FOR COMMON-ANODE DIODES

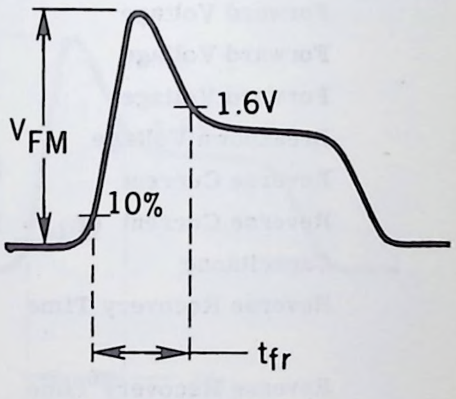
(4) Capacitance cannot conveniently be measured on individual diodes due to contributions of other diodes in the array. Limit listed is for pin-to-pin capacitance across any one of the diodes (i.e., 1 to 2, 1 to 3, etc. or 10 to 2, 10 to 3, etc.)

(5) Test Circuit for V_{FM} and t_{fr} is as shown below:



INPUT CURRENT PULSE





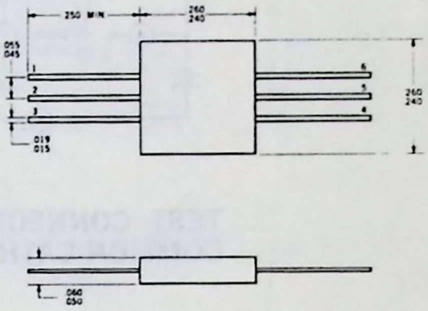
OUTPUT VOLTAGE PULSE

FSA2001

ULTRA FAST, EIGHT DIODE, CORE DRIVER ARRAY

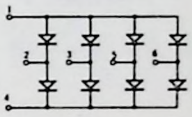
SILICON PLANAR* EPITAXIAL CONSTRUCTION

ERAL DESCRIPTION – These Silicon Planar Epitaxial Diode Arrays were designed cially for high-speed core driver applications. They are hermetically sealed in a ceramic age. The excellent thermal conductivity of the ceramic permits operation to 400 mW.



NOTES All dimensions in inches
Leads are .0065/.0035 thick kovar

CIRCUIT DIAGRAM



IMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_o	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
P/θ	Power Derating Factor	3.2 mW/°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

TRICAL CHARACTERISTICS (25°C unless otherwise noted)

mbol	Characteristic	Min.	Max.	Units	Test Conditions	
11	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
22	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
33	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
	Breakdown Voltage	60		V	I_R = 100 μA	
1	Reverse Current		100	nA	V_R = -40 V	(Note 3)
2	Reverse Current		100	μA	V_R = -40 V	(Note 3)
	Capacitance		8.0	pf	V_R = 0, f = 1 MHz	(Note 4)
11	Reverse Recovery Time		25	ns	$I_F = I_R$ = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
22	Reverse Recovery Time		90	ns	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
M	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq$ 10 ns	(Note 5)
	Forward Recovery Time		40	ns	I_F = 500 mA, $t_r \leq$ 10 ns Rec. to 1.6 V	(Note 5)

notes on back page)

* Planar is a patented Fairchild process.

FAIRCHILD
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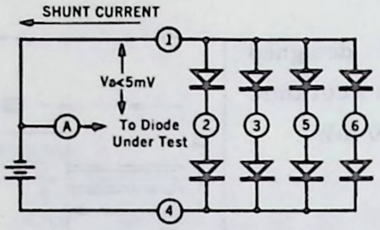
NOTES:

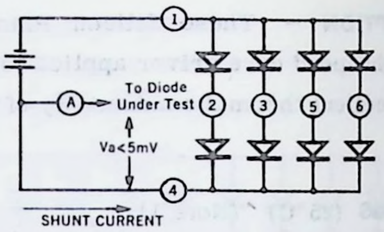
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Reverse current measurements between terminals result in substantial leakage contributions from other diodes in the array. To measure diodes individually (specification limit is for individual diodes), current may be shunted by employing following test configuration.



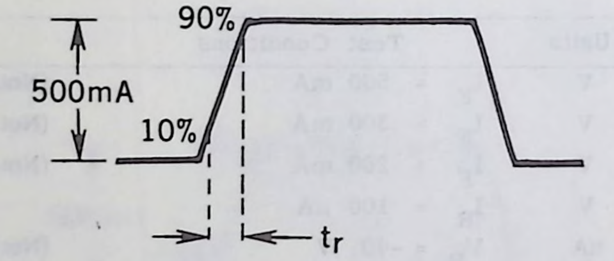
TEST CONNECTIONS FOR COMMON-CATHODE DIODES



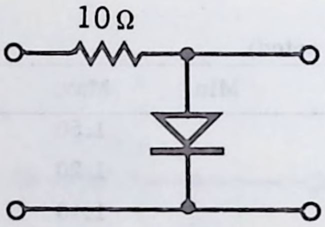
TEST CONNECTIONS FOR COMMON-ANODE DIODES

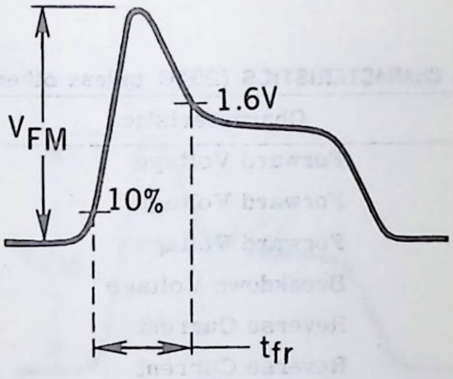
(4) Capacitance cannot conveniently be measured on individual diodes due to contributions of other diodes in the array. Limit listed is for pin-to-pin capacitance across any one of the diodes (i.e., 1 to 2, 1 to 3, etc. or 4 to 2, 4 to 3, etc.)

(5) Test Circuit for V_{FM} and t_{fr} is as shown below:



INPUT CURRENT PULSE





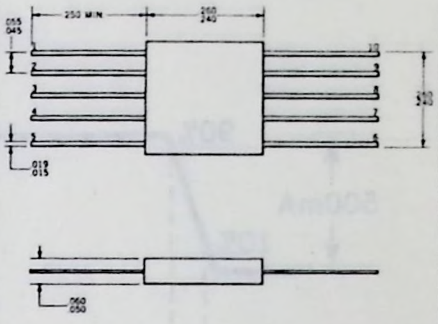
OUTPUT VOLTAGE PULSE

FSA2002

ULTRA FAST, EIGHT DIODE, COMMON-CATHODE ARRAY

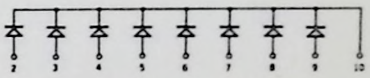
SILICON PLANAR EPITAXIAL CONSTRUCTION

ENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed specially for high-speed core driver applications. They are hermetically sealed in a ceramic ackage. The excellent thermal conductivity of the ceramic permits operation to 400 mW.



NOTES 1. All dimensions in inches
Leads are .0065/.0035 thick kovar
2. No connection to pin 1

CIRCUIT DIAGRAM



AXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_o	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
$\frac{1}{\theta}$	Power Derating Factor	3.2 mW°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{F1}	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
V_{F2}	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
V_{F3}	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
BV	Breakdown Voltage	60		V	I_R = 100 μA	
I_{R1}	Reverse Current		100	nA	V_R = -40 V	
I_{R2}	Reverse Current (T_A = 150°C)		100	μA	V_R = -40 V	
C	Capacitance		3.0	pf	V_R = 0, f = 1 MHz	
t_{rr1}	Reverse Recovery Time		25	ns	$I_F = I_R$ = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
t_{rr2}	Reverse Recovery Time		90	ns	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
V_{FM}	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq$ 10 ns	(Note 3)
t_{fr}	Forward Recovery Time		40	ns	I_F = 500 mA, $t_r \leq$ 10 ns Rec. to 1.6 V	(Note 3)

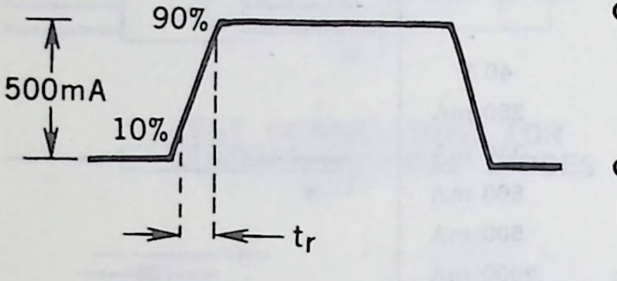
e notes on back page)

NOTES:

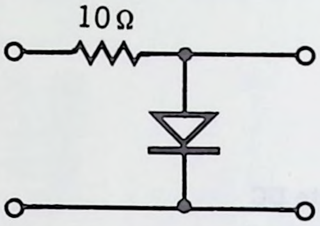
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

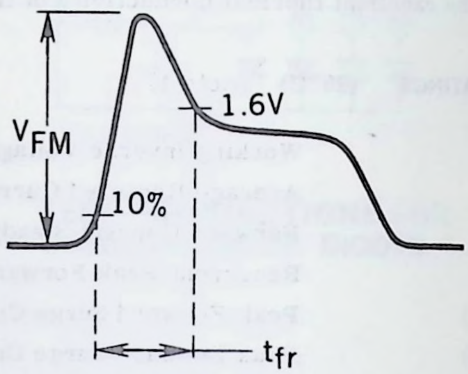
(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Test Circuit for V_{FM} and t_{fr} is as shown below:



INPUT CURRENT PULSE





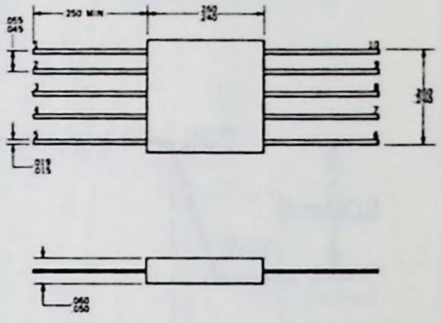
OUTPUT VOLTAGE PULSE

FSA2003

ULTRA FAST, EIGHT DIODE, COMMON-ANODE ARRAY

SILICON PLANAR EPITAXIAL CONSTRUCTION

ENERAL DESCRIPTION - These Silicon Planar Epitaxial Diode Arrays were designed specially for high-speed core driver applications. They are hermetically sealed in a ceramic ckage. The excellent thermal conductivity of the ceramic permits operation to 400 mW.



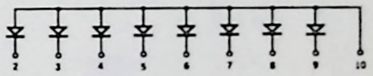
NOTES All dimensions in inches

Leads are $\frac{.0065}{.0035}$ thick kovar

AXIMUM RATINGS (25°C) (Note 1)

WIV	Working Inverse Voltage	40 V
I_o	Average Rectified Current	250 mA
I_F	Forward Current Steady State DC	330 mA
i_f	Recurrent Peak Forward Current	800 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 sec	500 mA
i_f(surge)	Peak Forward Surge Current Pulse Width of 1.0 μsec	2000 mA
P	Power Dissipation	400 mW
$\frac{1}{\theta}$	Power Derating Factor	3.2 mW/°C
T_A	Operating Temperature	-65°C to +150°C
T_{stg}	Storage Temperature, Ambient	-65°C to +175°C

CIRCUIT DIAGRAM



ECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{IF1}	Forward Voltage		1.50	V	I_F = 500 mA	(Note 2)
V_{IF2}	Forward Voltage		1.20	V	I_F = 300 mA	(Note 2)
V_{IF3}	Forward Voltage		1.10	V	I_F = 200 mA	(Note 2)
BV	Breakdown Voltage	60		V	I_R = 100 μA	
I_{RR1}	Reverse Current		100	nA	V_R = -40 V	
I_{RR2}	Reverse Current (T_A = 150°C)		100	μA	V_R = -40 V	
C	Capacitance		7.0	pf	V_R = 0, f = 1 MHz	
t_{rr1}	Reverse Recovery Time		25	ns	$I_F = I_R$ = 10 mA to 200 mA, R_L = 100 Ω, Rec. to 0.1 I_F	
t_{rr2}	Reverse Recovery Time		90	ns	I_F = 300 mA, I_R = 60 mA, R_L = 100 Ω, Rec. to 20 mA	
V_{IFM}	Peak Forward Voltage		5.0	V	I_F = 500 mA, $t_r \leq$ 10 ns	(Note 3)
t_{fr}	Forward Recovery Time		40	nsec	I_F = 500 mA, $t_r \leq$ 10 ns Rec. to 1.6 V	(Note 3)

e notes on back page)

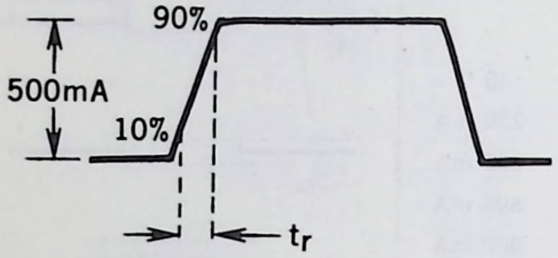
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

NOTES:

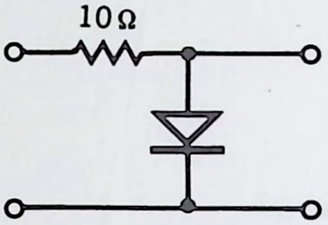
(1) Ratings apply to individual diodes. For multiple diode operation, total power must not exceed power dissipation rating listed.

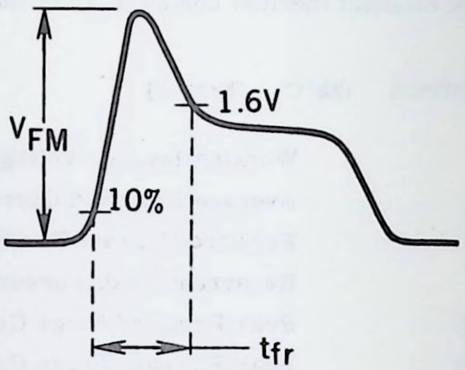
(2) Pulse Input Current - Duty cycle less than 1.0%.

(3) Test Circuit for V_{FM} and t_{fr} is as shown below:



INPUT CURRENT PULSE



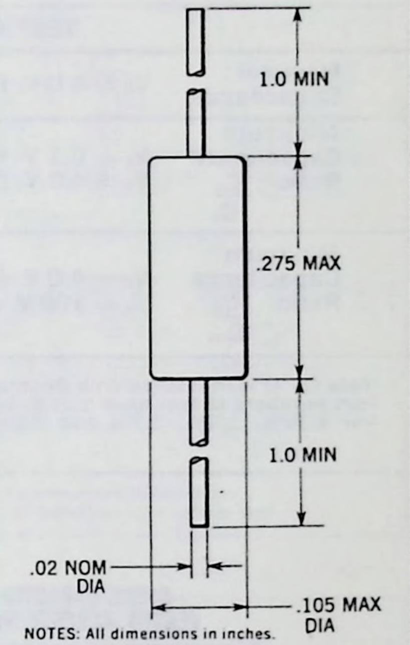


OUTPUT VOLTAGE PULSE

FV1006,08,10,12,14,16
FV1106,08,10,12,14,16
VOLTAGE VARIABLE CAPACITORS

ENERAL DESCRIPTION — Fairchild Silicon Voltage-Variable Capacitors (VVC) feature low leakage, igh Q, and high capacitance ratio. Principal applications of these devices are in A.F.C. circuits, elec- onic tuning circuits, filters and voltage-controlled crystal oscillators. The patented Fairchild Planar* rocess ensures excellent tracking characteristics, making this product ideally suited to applications here simultaneous tuning of several circuits is required.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Weight: 0.25 gram.

AXIMUM RATINGS

MWV	Maximum Working Voltage	
	Low Voltage Series:	60 V
	High Voltage Series:	100 V
	Forward Current	250 mA
	Power Dissipation	400 mW
A	Operating Temperature	−65°C to +150°C
stg	Storage Temperature	−65°C to +200°C

LOW VOLTAGE SERIES

ELECTRICAL SPECIFICATIONS (T_A = 25°C Unless Otherwise Noted)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	65			V	$I_R = 10\ \mu A$
I_R	Reverse Leakage Current			50	nA	$V_R = 60$ V
I_R	Reverse Leakage Current			50	μA	$V_R = 60$ V $T_A = 150°C$
Q	Figure of Merit	150	250			$V_R = 4$ V f = 50 MHz

	TEST CONDITIONS	UNITS	FV1006	FV1008	FV1010	FV1012	FV1014	FV1016
Nominal Capacitance	$V_R = 4.0$ V, f = 1.0 MHz	pF	6.8	10	15	22	33	47
Minimum Capacitance Ratio $\frac{C_{.1}}{C_4}$	$V_R = 0.1$ V, f = 1.0 MHz ($C_{.1}$) $V_R = 4.0$ V, f = 1.0 MHz (C_4)		2.2	2.2	2.2	2.2	2.2	2.2
Minimum Capacitance Ratio $\frac{C_4}{C_{60}}$	$V_R = 4.0$ V, f = 1.0 MHz (C_4) $V_R = 60$ V, f = 1.0 MHz (C_{60})		2.9	3.0	3.1	3.2	3.2	3.2

* Planar is a patented Fairchild proc

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

HIGH VOLTAGE SERIES

ELECTRICAL SPECIFICATIONS ($T_A = 25°C$ Unless Otherwise Noted)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	110			V	$I_R = 10\ \mu A$
I_R	Reverse Leakage Current			100	nA	$V_R = 100$ V
I_R	Reverse Leakage Current			100	μA	$V_R = 100$ V, $T_A = 150°C$
Q	Figure of Merit [Note 1]	150	250			$V_R = 4$ V f = 50 MHz

	TEST CONDITIONS	UNITS	FV1106	FV1108	FV1110	FV1112	FV1114	FV1116
Nominal Capacitance	$V_R = 4.0$ V, f = 1.0 MHz	pF	6.8	10	15	22	33	47
Minimum Capacitance Ratio $\frac{C_{.1}}{C_4}$	$V_R = 0.1$ V, f = 1.0 MHz ($C_{.1}$) $V_R = 4.0$ V, f = 1.0 MHz (C_4)		2.2	2.2	2.2	2.2	2.2	2.2
Minimum Capacitance Ratio $\frac{C_4}{C_{100}}$	$V_R = 4.0$ V, f = 1.0 MHz (C_4) $V_R = 100$ V, f = 1.0 MHz (C_{100})		3.5	3.7	3.9	4.0	4.1	4.15

Note (1) Q is measured on a Boonton 33A Admittance Bridge.
Part numbers shown have ±20% tolerance.
For ±10%, ±5%, ±2% and ±1% specify part number with A, B, C and D suffixes, respectively.

TYPICAL ELECTRICAL CHARACTERISTICS (25°C)

DIODE CAPACITANCE VERSUS REVERSE VOLTAGE

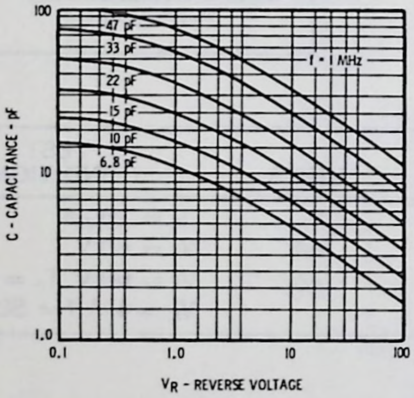


FIGURE OF MERIT VERSUS REVERSE VOLTAGE

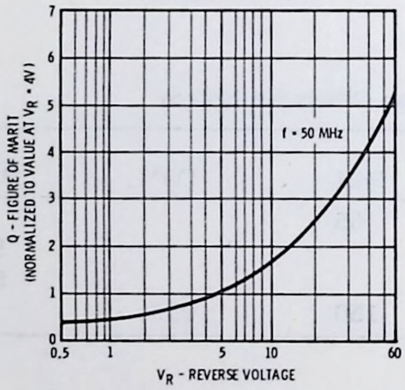
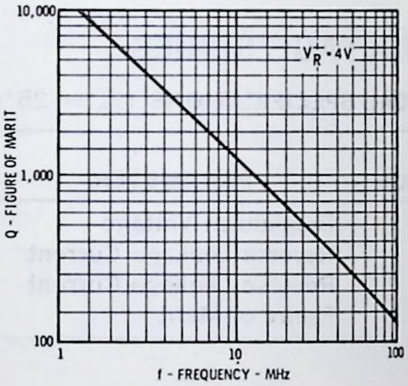


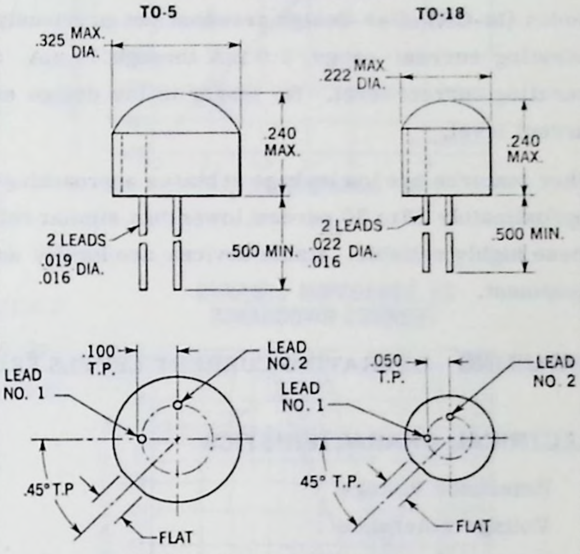
FIGURE OF MERIT VERSUS FREQUENCY



FAIRCHILD SILICON PLANAR* ZENER DIODES
100 MILLIWATT VOLTAGE REGULATORS
FZ900 SERIES & FZ950 SERIES

ENERAL DESCRIPTION — The Fairchild General Purpose FZ900 and FZ950 silicon lanar* zener diodes are designed for voltage limiting applications and voltage reg-lation and offer controlled voltage breakdown and Planar reliability. These devices e available in epoxy TO-5 and TO-18 packages and are especially suited for circuit onomy applications.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
White dot identifies cathode lead

AXIMUM RATINGS (1)

Maximum zener current	10 mA
Power dissipation	100 mW
Operating temperature	−55°C to +125°C Maximum
Storage temperature	−55°C to +125°C Maximum

ECTRICAL CHARACTERISTICS (25°C)

TYPE NO.		V_Z NOMINAL ZENER VOLTAGE	Z_Z MAX. ZENER IMPEDANCE		I_R MAX. REVERSE CURRENT	ΔBV MAX. REGULATION (2)	T.C. TEMPERATURE COEFFICIENT (3)
		I_{ZT} = 2mA	Z_{ZT} @ 2mA	Z_{ZK} @ 250μA			
TO-18	TO-5	Volts	Ohms	Ohms	μA	Volts	%/°C
FZ 901	—	5.6 ±10%	100	750	10μA @ V_R = 4V	0.40	0.035
FZ 902	FZ 952	6.5 ±10%	50	750	5μA @ V_R = 5V	0.40	0.035
FZ 903	FZ 953	10.6 ±10%	50	750	5μA @ V_R = 8V	0.40	0.035

* Planar is a patented Fairchild process.

OTES:

) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

) ΔBV (V_Z Regulation: It is the change in V_Z when measured at I_Z = 1 mA to V_Z measured at I_Z = 5 mA.

) $TC = \frac{(V_{T1} - V_{T2})}{V(T_1 - T_2)}$ where $V = \frac{V_{T1} + V_{T2}}{2}$
(V stands for Zener voltage.)

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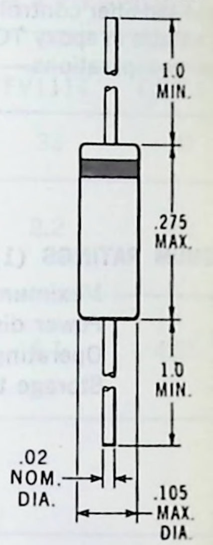
M-CR

SILICON PLANAR MULTI-CURRENT RANGE REFERENCE DIODES

GENERAL DESCRIPTION These unique Fairchild Temperature Compensated Multi-Current Range Diodes (M-CR) offer design freedom not previously available with reference diodes. Their broad operating current range, 1.0 mA through 15 mA, allows considerable freedom in selection of the operating current level. No longer is the design engineer restricted to a 7.5-mA and/or 10-mA current level.

Other features are low leakage at biases approaching the breakdown voltage, low dynamic impedance—approximately 20 to 30 percent lower than similar reference devices, and TC as low as 0.0005 percent. These highly reliable, stable devices are ideally suited for applications in space vehicles and test equipment.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches. Weight: 0.25 gram.

FEATURING OPERATING CURRENT LEVELS FROM 1.0 THROUGH 15.0 mA

ELECTRICAL CHARACTERISTICS

Reference Voltage	6.6 Volts
Voltage Tolerance	± 5%
Reverse Leakage Maximum	200 nano amperes at 3.0 Volts at 25°C
Package DO-7 glass	
Operating Temperature	- 55°C to +100°C

TYPE		CURRENT RANGE	TEMPERATURE COEFFICIENT (Max) %/°C (Note 1)		IMPEDANCE (Max) Ohms
FSC	JEDEC	(Note 1)	I_Z = 2.0 ±0.2 mA	I_Z = 2.0 ±1.0 mA	(Note 2)
M-CR2225	1N4611	1-3 mA	0.005% at 2 mA	0.01%	75
M-CR2222	1N4611A		0.002% at 2 mA	0.005%	
M-CR2221	1N4611B		0.001% at 2 mA	0.002%	
M-CR2235	1N4611C		0.0005% at 2 mA	0.001%	
			I_Z = 5.0 ±0.5 mA	I_Z = 5 ±2.0 mA	
M-CR2525	1N4612	3-7 mA	0.005% at 5 mA	0.01%	25
M-CR2522	1N4612A		0.002% at 5 mA	0.005%	
M-CR2521	1N4612B		0.001% at 5 mA	0.002%	
M-CR2535	1N4612C		0.0005% at 5 mA	0.001%	
			I_Z = 10.0 ±1.0 mA	$I_Z = 10.0\ ^{+5.0}_{-3.0}$ mA	
M-CR2025	1N4613	7-15 mA	0.005% at 10 mA	0.01%	15
M-CR2022	1N4613A		0.002% at 10 mA	0.005%	
M-CR2021	1N4613B		0.001% at 10 mA	0.002%	
M-CR2035	1N4613C		0.0005% at 10 mA	0.001%	

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NOTES:

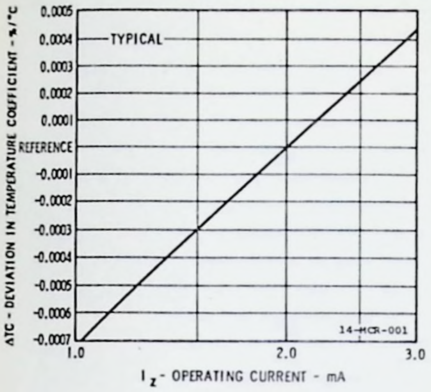
(1) Operating current may be set anywhere within the indicated current ranges and still exhibit a temperature coefficient equal to or less than the values listed. Temperature coefficient is determined by measuring V_z at the two temperature extremes and using the following formula:

$$T_C = \frac{(V_z \text{ at } -55°C - V_z \text{ at } +100°C)}{V_A(+155°C)}\ 100 \quad \text{where, } V_A = \frac{V \text{ at } -55°C + V \text{ at } +100°C}{2}$$

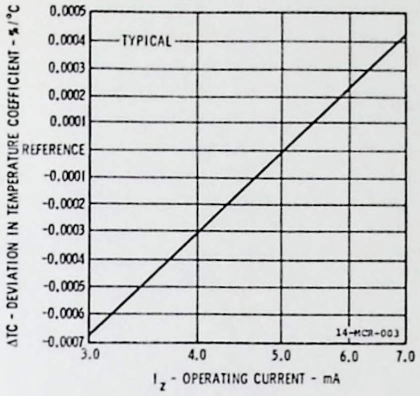
(2) Dynamic impedance is measured at the minimum operating current value (worst case). The M-CR2200 series is measured at IDC = 1.0 mA, M-CR2500 series at IDC = 3.0 mA, etc. IAC is 10% of IDC in all cases.

SILICON PLANAR MULTI-CURRENT RANGE REFERENCE DIODES

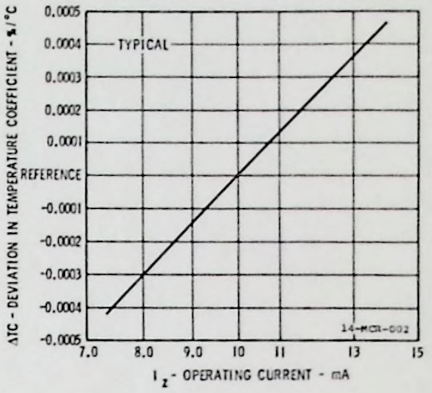
TEMPERATURE COEFFICIENT VS OPERATING CURRENT (MCR 22XX SERIES)



TEMPERATURE COEFFICIENT VS OPERATING CURRENT (MCR 25XX SERIES)



TEMPERATURE COEFFICIENT VS OPERATING CURRENT (MCR 20XX SERIES)



The REFERENCE line on the vertical scale (ΔT_C) of the TEMPERATURE COEFFICIENT VS OPERATING CURRENT graphs represents the temperature coefficient of the device at 2, 5, or 10 mA depending on the type. The typical temperature coefficients are:

T_C at $I_X = T_C$ at $I_Z = 2\text{ mA} + \Delta T_C$ (M-CR 22XX Series)

T_C at $I_X = T_C$ at $I_Z = 5\text{ mA} + \Delta T_C$ (M-CR 25XX Series)

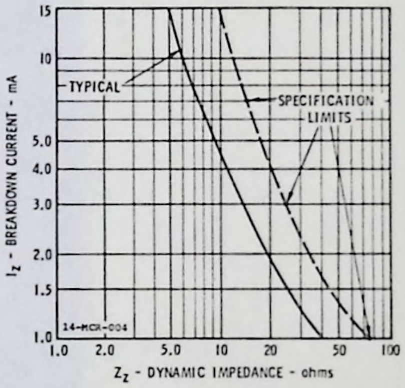
T_C at $I_X = T_C$ at $I_Z = 10\text{ mA} + \Delta T_C$ (M-CR 20XX Series)

where

I_X = any current within the range quoted for the series.

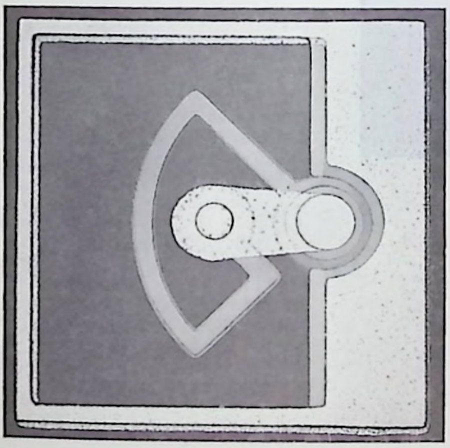
ΔT_C = temperature coefficient deviation shown on graphs at $I_Z = I_X$

DYNAMIC IMPEDANCE VS BREAKDOWN CURRENT

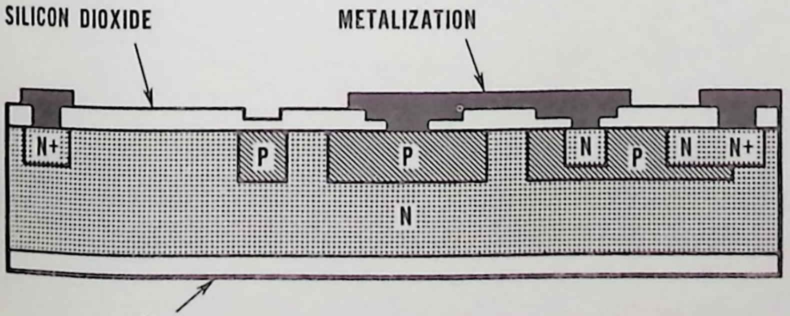


M-CR DIODE: INTEGRATED CIRCUIT IN DO-7 PACKAGE

Fairchild M-CR diodes are actually Monolithic Silicon Integrated Circuits composed of three elements; an NPN transistor, a zener diode, and a resistor. These elements are a result of multiple diffusions into a single n-type silicon wafer. The integrated circuit approach eliminates the interconnections that would be necessary in fabricating the circuit with discrete devices.

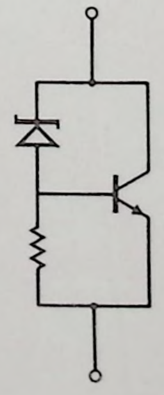


PHOTOMICROGRAPH OF THE M-CR



CROSS SECTION OF M-CR DIODE

CIRCUIT DIAGRAM



14-MCR-006

Special Transistor Products

Differential Amplifiers
Darlington Amplifiers
Dual Transistors
Epoxy Dual Transistors

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DIFFERENTIAL AMPLIFIER SELECTION GUIDE

NPN Type	Case Type	Equivalent Single ***Device	LV_{CEO} Volts min.	V_{BE} Match mV max.	H_{FE} Match Percent	H_{FE} @ Match min.	max.	$\Delta V_{BE1} - \Delta V_{BE2}$ ‡‡μV/°C max.	Data Shee Filed Unde
2N2060	TO - 77*	2N1893	60	5.0	10	30	90	10	2N206
2N2060A	TO - 77*	2N1893	60	3.0	10	30	90	10	2N206
2N2060B	TO - 77*	2N1893	60	1.5	10	30	90	5	2N206
2N2223	TO - 77*	2N1711	60	15.0	—	25	150	25	—
2N2223A	TO - 77*	2N1711	60	5.0	—	25	150	25	—
2N2915	TO - 77*	2N2484	45	3.0	10	100	—	10	2N291
2N2915A	TO - 77*	2N2484	45	1.5	10	100	—	5	2N291
2N2916	TO - 77*	2N3117	45	3.0	10	225	—	10	2N291
2N2916A	TO - 77*	2N3117	45	1.5	10	225	—	5	2N291
2N2917	TO - 77*	2N2484	45	5.0	20	100	—	20	2N291
2N2918	TO - 77*	2N3117	45	5.0	20	225	—	20	2N291
2N2919	TO - 77*	2N2484	60	3.0	10	100	—	10	2N291
2N2919A	TO - 77*	2N2484	60	1.5	10	100	—	5	2N291
2N2920	TO - 77*	2N3117	60	3.0	10	225	—	10	2N291
2N2920A	TO - 77*	2N3117	60	1.5	10	225	—	5	2N291
2N2974	TO - 71	2N2484	45	3.0	10	100	—	10	2N291
FT2974	TO - 71	2N2484	45	1.5	10	100	—	5	2N291
2N2975	TO - 71	2N3117	45	3.0	10	225	—	10	2N291
FT2975	TO - 71	2N3117	45	1.5	10	225	—	5	2N291
2N2976	TO - 71	2N2484	45	5.0	20	100	—	20	2N291
2N2977	TO - 71	2N3117	45	5.0	20	225	—	20	2N291
2N2978	TO - 71	2N2484	60	3.0	10	100	—	10	2N291
FT2978	TO - 71	2N2484	60	1.5	10	100	—	5	2N291
2N2479	TO - 71	2N3117	60	3.0	10	225	—	10	2N291
FT2979	TO - 71	2N3117	60	1.5	10	225	—	5	2N291
2N2980	TO - 71	2N1893	60	5.0	10	30	90	10	2N298
2N2981	TO - 71	2N1893	60	15.0	20	25	150	25	2N298
2N2982	TO - 71	2N1893	60	5.0	10	25	150	15	2N298
2N3423	TO - 77*	2N918	15	10.0	20	20	—	40	2N342
2N3424	TO - 77*	2N918	15	5.0	10	20	—	20	2N342
FE3424	TO - 89	2N918	15	5.0	10	20	—	20	2N342
2N3728	TO - 78	2N2222	30	5.0	20	45	180	20	2N372
2N3729	TO - 78	2N2222	30	3.0	10	45	180	10	2N372
2N4956	TO - 78**	2N2484	25	5.0	20	100	—	20	2N495
SP10801	TO - 89		45	5.0	20	100	—	20	SP108

*Devices have been re-registered to permit use of either full-height dual TO - 5 (TO - 77) or low profile dual TO - 5 (TO - 78).
**Epoxy dual TO - 5 (6 leaded TO - 105).
***Devices also available in TO - 71 (TO - 18 Dual) and TO - 89 (Dual Flatpack).
‡‡T_A = —55°C to +125°C.

DIFFERENTIAL AMPLIFIER SELECTION GUIDE

*PNP Type	Case Type	Equivalent Single ***Device	LV_{CEO} Volts min.	V_{BE} Match mV max.	H_{FE} Match Percent	H_{FE} @ Match min.	max.	$\Delta V_{BE}/\Delta T$ ‡‡μV/°C max.	Data Sheet Filed Under
FT1718A	TO - 78	2N3251	40	1.5	10	160	350	10	FT1718A
FT1718B	TO - 78	2N3250	40	1.5	10	70	250	10	FT1718A
FT1718C	TO - 78	2N3251	40	3.0	10	160	350	20	FT1718A
FT1718D	TO - 78	2N3250	40	3.0	10	70	250	20	FT1718A
2N3726	TO - 78	2N2907	45	5.0	10	120	—	20	2N3426
2N3727	TO - 78	2N2907	45	2.5	10	120	—	10	2N3426
2N4015	TO - 78	2N2907A	60	5.0	10	120	—	20	2N3426
2N4016	TO - 78	2N2907A	60	2.5	10	120	—	10	2N3426
2N4020	TO - 78	2N3964	45	5.0	20	250	600	20	2N4020
2N4021	TO - 78	2N3962	60	5.0	20	100	500	20	2N4020
2N4022	TO - 78	2N3965	60	5.0	20	250	600	20	2N4020
FT4022	TO - 71	2N3965	60	5.0	20	250	600	20	2N4020
2N4023	TO - 78	2N3964	45	3.0	10	250	600	10	2N4020
FT4023	TO - 71	2N3964	45	3.0	10	250	600	10	2N4020
2N4024	TO - 78	2N3962	60	3.0	10	100	500	10	2N4020
FT4024	TO - 71	2N3962	60	3.0	10	100	500	10	2N4020
2N4025	TO - 78	2N3965	60	3.0	10	250	600	10	2N4020
FT4025	TO - 71	2N3965	60	3.0	10	250	600	10	2N4020
2N5255	TO - 78**	2N4250	40	5.0	20	150	750	20	2N5254
2N5256	TO - 78**	2N4250	40	3.0	10	150	750	10	2N5254
SP10810	TO - 89		15	5.0	20	35	—	50	SP10810

*Devices also available in TO - 71 (TO - 18 Dual) and TO - 89 (Dual Flatpack).
**Epoxy package (6 leaded TO - 105).
‡‡T_A = —55°C to +125°C.

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DARLINGTON AMPLIFIER TRANSISTORS SELECTION GUIDE

Device Type	Polarity	Case Type	BV_{CE} Volts (min)	h_{FE} $I_C = 100\mu A$ (min)	(max)	h_{FE} $I_C = 1.0mA$ (min)	(max)	h_{FE} $I_C = 10nA$ (min)	(max)	h_{FE} $I_C = 100mA$ (min)	(max)
2N997	NPN	TO - 72	40	1,000	—	—	—	4,000	—	7,000	70,000
2N998	NPN	TO - 72	60	—	—	800	—	1,600	8,000	2,000	—
2N999	NPN	TO - 72	60	1,000	—	—	—	4,000	—	7,000	70,000
2N2723	NPN	TO - 72	60	—	—	—	—	2,000	10,000	—	—
2N2724	NPN	TO - 72	60	—	—	—	—	7,000	50,000	—	—
2N2725	NPN	TO - 72	45	2,000	10,000	—	—	2,000	10,000	—	—
2N2785	NPN	TO - 72	40	—	—	600	—	1,200	—	2,000	20,000
2N4974	PNP	TO - 12*	30	20,000	—	25,000	50,000	30,000	60,000	25,000	50,000
2N4975	PNP	TO - 12*	30	10,000	—	15,000	30,000	15,000	30,000	15,000	30,000

DARLINGTON AMPLIFIER TRANSISTOR NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
2N997	6-1	2N998	6-2	2N999	6-4

DUAL TRANSISTORS SELECTION GUIDE — AMPLIFIER APPLICATIONS

Device Type	Polarity	Case Type	Equivalent Single *Device	LV_{CEO} Volts (min)	h_{FE} @ I_C (min)	(max)	mA	f_t MHz (min)	N.F. f = 1kHz db (max)	Data Sheet Filed Under
FT1718E	PNP	TO - 78	2N3250	20	70	350	0.1	400	6	FT1718
2N2913	NPN	TO - 78	2N2483	45	60	240	0.01	60	4	2N2913
2N2914	NPN	TO - 78	2N2484	45	150	600	0.01	60	3	2N2913
2N2972	NPN	TO - 71	2N2483	45	60	240	0.01	60	4	2N2913
2N2973	NPN	TO - 71	2N2484	45	150	600	0.01	60	3	2N2913
2N4017	PNP	TO - 78	2N3963	80	100	350	0.01	40	3	2N4017
FT4017	PNP	TO - 71	2N3963	80	100	350	0.01	40	3	2N4017
2N4018	PNP	TO - 78	2N3962	60	100	500	0.01	40	3	2N4017
FT4018	PNP	TO - 71	2N3962	60	100	500	0.01	40	3	2N4017
2N4019	PNP	TO - 78	2N3964	45	250	500	0.01	50	2	2N4017
FT4019	PNP	TO - 71	2N3964	45	250	500	0.01	50	2	2N4017
SP10800	NPN	TO - 89	2N2484	45	60	600	0.01	65	4	SP10800
SP10811	PNP	TO - 89	—	15	35	—	10.0	100	—	SP10811

*Devices also available in TO - 71 (TO - 18 Dual) and TO - 89 (Dual Flatpack)

DUAL TRANSISTORS SELECTION GUIDE — SWITCHING APPLICATIONS

vices ype	Polarity	*Case Type	Single Device 2N No.	LV_{CEO} Volts (min)	Current Range mA (min)	(max)	f_t MHz (min)	t_{on} nsec (max)	t_{off} nsec (max)
34225	NPN	TO - 77	2N914	15	0.1	500	300	40	40
S3000	NPN	TO - 77*	2N708	15	0.1	200	300	10	40
S3001	NPN	TO - 77*	2N709	6	.01	100	500	15	15
S3007	PNP	TO - 77*	2N995	15	0.1	200	100	65*	125*
S3114	NPN	TO - 77*	2N2369	10	0.1	300	400	12	18
S6668	PNP	TO - 77*	2N2894	12	0.1	300	400	60	90

vices also available in TO - 71 (TO - 18 Dual) and TO - 89 (Dual Flatpack)

DUAL TRANSISTOR NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
FT1718E	6-6	2N4017	6-44	2N4019	6-44
2N2913	6-12	FT4017	6-48	FT4019	6-48
2N2914	6-12	2N4018	6-44	SP10800	6-66
2N2972	6-12	FT4018	6-48	SP10811	6-72
2N2973	6-12				

EPOXY DUAL TRANSISTORS (6 lead TO - 105) SELECTION GUIDE

vice ype	Polarity	Equivalent Single Device	LV_{CEO} Volts (min)	V_{BE} Match mV (max)	H_{FE} Match Percent	H_{FE} @ Match (min)	(max)	$\Delta V_{BE1} - \Delta V_{BE2}$ $T_A = -40°C$ to $+85°C$ $\mu V/°C$ max
4955	NPN	2N3565	25	—	—	100	—	—
4956	NPN	2N3565	25	5	20	100	—	20
5254	PNP	2N4249	60			50	750	
5255	PNP	2N4250	40	5	20	150	750	20
5256	PNP	2N4250	40	3	10	150	750	10

EPOXY DUAL TRANSISTOR NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
2N4955	6-60	2N5254	6-62	2N5256	6-62
2N4956	6-60	2N5255	6-62		

2N997

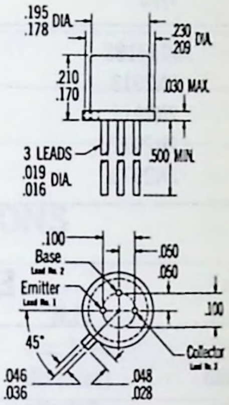
NPN HIGH GAIN COMPOUND AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

FOR IMPROVED PERFORMANC
SEE FAIRCHILD 2N99

GENERAL DESCRIPTION - The Fairchild 2N997 contains two NPN silicon PLANAR transistors connected as a compound amplifier. It is designed primarily for circuits requiring very high gain and high input impedance.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.4 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.5 Watts
at 25°C Free Air Temperature (Notes 2 and 3)	0.5 Watt

Maximum Voltages and Currents

V_{CBO}	Collector to Base Voltage	75 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts
I_C	Collector Current	300 mA
I_B	Base Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Pulse Current Gain (Note 5)	7,000	70,000		I_C = 100 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	4,000			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	DC Current Gain	1,000			I_C = 100 μA	V_{CE} = 10 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	1,000			I_C = 100 mA	V_{CE} = 10 V
V_{CE}(sat)	Collector-Emitter Saturation Voltage (Note 5)		1.6	Volts	I_C = 100 mA	I_B = 1.0 mA
V_{BE}	Base-Emitter Voltage (Note 5)	0.9	1.8	Volts	I_C = 100 mA	V_{CE} = 10 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 60 V
I_{CBO}(150°C)	Collector Cutoff Current		10	μA	I_E = 0	V_{CB} = 60 V
I_{EBO}	Emitter Cutoff Current		10	nA	I_C = 0	V_{EB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	75		Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 5)	40		Volts	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		Volts	I_C = 0	I_E = 100 μA

* Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction-to-case thermal resistance of 100°C/Watt (derating factor of 10 mW/°C); junction-to-ambient thermal resistance of 300°C/Watt (derating factor of 3.33 mW/°C).

(4) Rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle ≤ 2%.

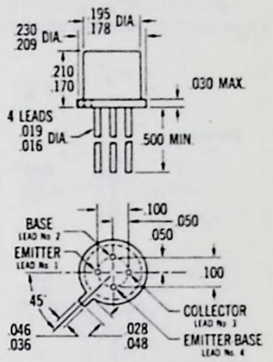
2N998

NPN ULTRA HIGH GAIN COMPOUND AMPLIFIER

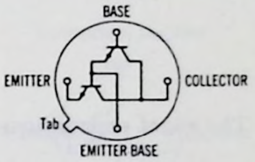
DIFFUSED SILICON PLANAR* TRANSISTOR

GENERAL DESCRIPTION - The 2N998 is a 4 terminal device containing two high gain silicon Planar transistors connected as a Darlington compound amplifier in one hermetically sealed enclosure. This device is particularly useful in circuits requiring a very high gain, high input impedance and low noise unit. A fourth lead is provided making all terminals of both devices accessible.

PHYSICAL DIMENSIONS
in accordance with JEDEC (TO-18) outline



CONNECTION DIAGRAM



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight 0.44 grams

BSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures			
Storage Temperature			-65°C to +300°C
Operating Junction Temperature			+200°C Maximum
Lead Temperature (Soldering, No Time Limit)			+300°C Maximum
Maximum Power Dissipation			
Total Dissipation at 25°C Case Temperature		[Note 2 & 3]	1.8 Watts
at 100°C Case Temperature		[Note 2 & 3]	1.0 Watt
at 25°C Ambient Temperature			0.5 Watt
Maximum Voltages			
V_{CBO}	Collector to Base Voltage		100 Volts
V_{CEO}	Collector to Emitter Voltage	[Note 4]	60 Volts
V_{EBO}	Emitter to Base Voltage		15 Volts

LECTRICAL CHARACTERISTICS (25°C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	Pulsed DC Current Gain [Note 5]	1600	8000		I_C = 10 mA	V_{CE} = 5.0 V
h_{FE}	Pulsed DC Current Gain [Note 5]	2000			I_C = 100 mA	V_{CE} = 5.0 V
h_{FE}	DC Current Gain	800			I_C = 1.0 mA	V_{CE} = 5.0 V
V_{BE} (sat)	Base Saturation Voltage		1.8	Volts	I_C = 50 mA	I_B = 0.5 mA
V_{CE} (sat)	Collector Saturation Voltage		1.2	Volts	I_C = 50 mA	I_B = 0.5 mA
C_{obo}	Output Capacitance		30	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		50	pF	I_C = 0	V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		10	mμA	I_E = 0	V_{CB} = 90 V
I_{CBO} (150°C)	Collector Cutoff Current		15	μA	I_E = 0	V_{CB} = 90 V
I_{EBO}	Emitter Cutoff Current		10	mμA	I_C = 0	V_{EB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	100		Volts	I_C = 100 μA	I_E = 0
V_{CEO}	Collector to Emitter Sustaining Voltage [Note 4]	60		Volts	I_C = 30 mA (Pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	15		Volts	I_C = 0	I_E = 100 μA
NF	Noise Figure [Note 6] (Power Bandwidth = 200 Hz)		6.0	dB	I_C = 0.1 mA f = 1.0 kHz	V_{CE} = 10 V R_g = 5.0 Kohms

* Planar is a patented Fairchild process.

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NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 97.2°C/Watt (derating factor of 10.3 mW/°C).

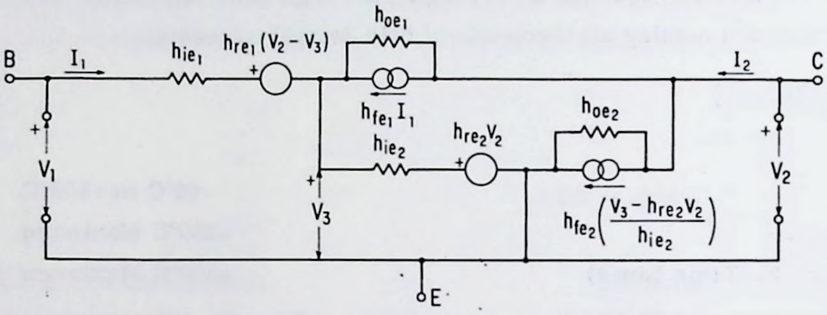
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

(6) Measured with a constant-current supply of 20 μA connected to the emitter of the input transistor.

SMALL SIGNAL ANALYSIS

The common emitter hybrid parameters of the compound amplifier may be determined by analysis of the equivalent circuit shown below.



By definition: $h_{ie} = \frac{V_1}{I_1}\Big/_{V_2 = 0}$ $h_{oe} = \frac{I_2}{V_2}\Big/_{I_1 = 0}$ $h_{re} = \frac{V_1}{V_2}\Big/_{I_1 = 0}$ $h_{fe} = \frac{I_2}{I_1}\Big/_{V_2 = 0}$

The exact expressions can be shown to be:

$$h_{ie} = h_{ie_1} + \frac{(1 - h_{re_1})(1 + h_{fe_1})\,h_{ie_2}}{h_{oe_1}h_{ie_2} + 1}$$

$$h_{fe} = h_{fe_1} + \frac{(h_{fe_2} - h_{oe_1}h_{ie_2})(1 + h_{fe_1})}{h_{oe_1}h_{ie_2} + 1}$$

$$h_{oe} = h_{oe_2} + \frac{(1 + h_{fe_2})(1 - h_{re_2})\,h_{oe_1}}{h_{oe_1}h_{ie_2} + 1}$$

$$h_{re} = h_{re_2} + \frac{(h_{ie_2}h_{oe_1} + h_{re_1})(1 - h_{re_2})}{h_{oe_1}h_{ie_2} + 1}$$

Where the subscripts 1 and 2 refer to the input and output transistors, respectively.

By considering typical values of the h parameters of the individual transistors we can make the following statements:

$h_{oe_1}h_{ie_2} << 1$ $h_{re_1} << 1$

$h_{oe_1}h_{ie_2} << h_{fe_2}$ $h_{re_2} << 1$

The above equations suggest these approximate formulas for the h parameters:

$h_{ie} \simeq h_{ie_1} + h_{ie_2} + h_{fe_1}h_{ie_2}$ $h_{re} \simeq h_{re_1} + h_{re_2} + h_{ie_2}h_{oe_1}$

$h_{oe} \simeq h_{oe_1} + h_{oe_2} + h_{fe_2}h_{oe_1}$ $h_{fe} \simeq h_{fe_1} + h_{fe_2} + h_{fe_1}h_{fe_2}$

COMMON EMITTER PARAMETERS MEASURED AT f = 1 kHz, I_C = 1 mA, V_{CE} = 5 V

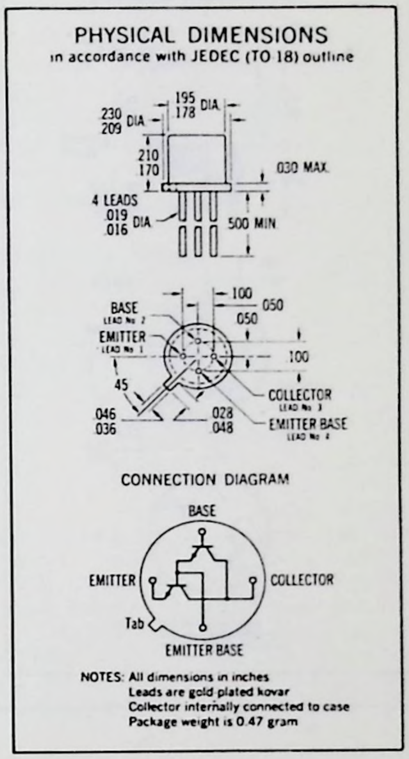
Symbol	Characteristic	Typical Value
h_{ie}	Input resistance, output shorted	40 k ohms
h_{oe}	Output conductance, input open	130 μmhos
h_{re}	Reverse open-circuit voltage amplification factor	4×10^{-3}
h_{fe}	Forward short-circuit current amplification factor	1200

2N999

NPN HIGH GAIN COMPOUND AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

ENERAL DESCRIPTION - The Fairchild 2N999 is a four terminal device containing two high-gain licon PLANAR transistors connected as a compound amplifier in one hermetically sealed enclosure. is device is particularly useful in circuits requiring very high gain and high input impedance.


PHYSICAL DIMENSIONS
in accordance with JEDEC (TO 18) outline
230
209 DIA
195
178 DIA
210
170
030 MAX
4 LEADS
.019
.016 DIA
500 MIN
100
050
050
BASE
LEAD No 2
EMITTER
LEAD No 1
100
45
COLLECTOR
LEAD No 3
046
036
028
048
EMITTER BASE
LEAD No 4
CONNECTION DIAGRAM
BASE
EMITTER
COLLECTOR
Tab
EMITTER BASE

NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.47 gram

BSOLUTE MAXIMUM RATINGS AS A COMPOUND AMPLIFIER (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +300°C
Operating Junction Temperature	200°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.8 Watts
at 100°C Case Temperature (Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.5 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	15 Volts
I_C	Collector Current	500 mA

ECTRICAL CHARACTERISTICS AS A COMPOUND AMPLIFIER (25°C Free air temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	Total DC Pulse Current Gain (Note 5)	7,000	70,000		I_C = 100 mA	V_{CE} = 10 V
h_{FE}	Total DC Pulse Current Gain (Note 5)	4,000			I_C = 10 mA	V_{CE} = 10 V
h_{FE}	Total DC Current Gain	1,000			I_C = 100 μA	V_{CE} = 10 V
h_{FE} (-55°C)	Total DC Pulse Current Gain (Note 5)	1,000			I_C = 100 mA	V_{CE} = 10 V
V_{CE} (sat)	Collector Saturation Voltage		1.6	Volts	I_C = 100 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage		1.8	Volts	I_C = 100 mA	I_B = 1.0 mA
C_{obo}	Output Capacitance		20	pF	I_E = 0	V_{CB} = 10 V
C_{TE}	Emitter Transition Capacitance		10	pF	I_C = 0	V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 60 V
I_{CBO} (150°C)	Collector Cutoff Current		10	μA	I_E = 0	V_{CB} = 60 V
I_{EBO}	Emitter Cutoff Current		10	nA	I_C = 0	V_{EB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	60		Volts	I_C = 100 μA	I_E = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	60		Volts	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	15		Volts	I_C = 0	I_E = 100 μA

* Planar is a patented Fairchild process.

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 97.2°C/Watt (derating factor of 10.3 mW/°C); junction-to-ambient thermal resistance of 350°C/Watt (derating factor of 2.86 mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

FT1718A THROUGH FT1718E

PNP HIGH-GAIN, LOW-NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* II EPITAXIAL TRANSISTORS

- **TIGHT BETA MATCH . . . . 10% (MAX) AT 100 μA TO 1.0 mA**
- **LOW V_{BE} DIFFERENTIAL CHANGE . . . 10 μV/°C (MAX) AT 100 μA TO 1.0 mA**
- **LOW V_{BE} DIFFERENTIAL . . . . 1.5 mV (MAX) AT 100 μA**
- **HIGH BETA . . . . 160-350 AT 100 μA**
- **HIGH f_T . . . . 450 MHz (MIN) AT 10 mA**
- **LOW NOISE FIGURE . . . . 6.0 dB (MAX) AT 100 MHz**

ABSOLUTE MAXIMUM RATINGS (Note 1)

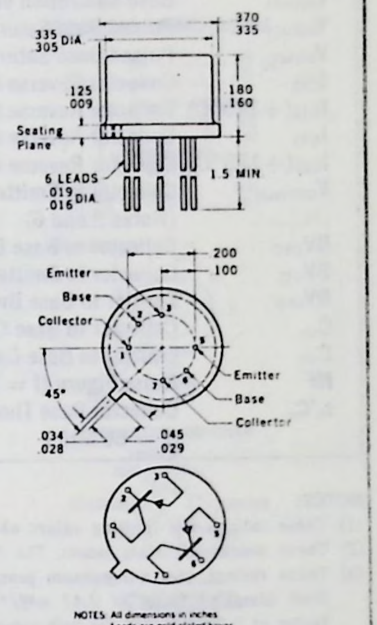
Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (soldering, 60 second time limit)	+300°C

Maximum Power Dissipation (Notes 2 and 3)	**One Side**	**Both Sides**
Total Dissipation at 25°C Case Temperature	0.635 Watt	1.1 Watts
at 25°C Ambient Temperature	0.33 Watt	0.432 Watt

Maximum Voltages and Current for Each Transistor		**FT1718A through FT1718D**	**FT1718E**
V_{CBO}	Collector to Base Voltage	−40 Volts	−20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 Volts	−20 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C	Collector Current	100 mA	100 mA

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 1.08 grams

MATCHING CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FT1718A FT1718B			FT1718C FT1718D				
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5)	**0.9**	**0.95**	**1.0**	0.9	0.95	1.0		**$I_C = 100\ \mu A$ TO 1.0 mA** **$V_{CE} = -5.0$ V**
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio Change (Note 5) (−55°C < +125°C)	0.85	0.93	1.0	0.85	0.93	1.0		$I_C = 100\ \mu A$ to 1.0 mA $V_{CE} = -5.0$ V
$\lvert V_{BE1} - V_{BE2} \rvert$	**Base to Emitter Voltage Differential**		**0.9**	**1.5**		1.8	3.0	mV	**$I_C = 100\ \mu A$ $V_{CE} = -5.0$ V**
$\lvert V_{BE1} - V_{BE2} \rvert$	Base to Emitter Voltage Differential		1.25	2.0		2.0	3.5	mV	$I_C = 100\ \mu A$ to 1.0 mA $V_{CE} = -5.0$ V
$\lvert \Delta(V_{BE1} - V_{BE2}) \rvert$	**Base to Emitter Voltage Differential Change** **(−55°C to +25°C)**		**0.5**	**0.8**		1.0	1.6	mV	**$I_C = 100\ \mu A$ to 1.0 mA** **$V_{CE} = -5.0$ V**
$\lvert \Delta(V_{BE1} - V_{BE2}) \rvert$	**Base to Emitter Voltage Differential Change** **(+25°C to +125°C)**		**0.75**	**1.0**		1.5	2.0	mV	**$I_C = 100\ \mu A$ to 1.0 mA** **$V_{CE} = -5.0$ V**

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted.)

		FT1718A FT1718C			FT1718B FT1718D			FT1718E				
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain	70	160		20	50		20	50			$I_C = 10\ \mu A$ $V_{CE} = -5.0$ V
h_{FE}	**DC Current Gain**	**160**	**200**	**350**	70	125	250	70	125	350		**$I_C = 100\ \mu A$ $V_{CE} = -5.0$ V**
h_{FE}	DC Current Gain	160	225		70	150		70	150			$I_C = 1.0$ mA $V_{CE} = -5.0$ V
h_{FE}	DC Pulse Current Gain (Note 6)	160	225		70	150		70	150			$I_C = 10$ mA $V_{CE} = -5.0$ V
h_{FE}(−55°C)	DC Current Gain	70	100		30	60		30	60			$I_C = 1.0$ mA $V_{CE} = -5.0$ V
h_{fe}	High Frequency Current Gain (f=100 MHz)	2.5	3.2		2.0	2.2		2.0	2.5			$I_C = 1.0$ mA $V_{CE} = -20$ V
h_{fe}	**High Frequency Current Gain (f=100 MHz)**	**4.5**	**6.0**		4.0	5.0		4.0	5.0			**$I_C = 10$ mA $V_{CE} = -20$ V**

*Planar is a patented Fairchild process.

FAIRCHILD
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FAIRCHILD TRANSISTORS FT1718A THROUGH FT1718E

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted.)

SYMBOL	CHARACTERISTICS	FT1718A FT1718C			FT1718B FT1718D			FT1718E				TEST CONDITIONS	
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS		
$V_{CE(sat)}$	Collector Saturation Voltage		−0.07	−0.13		−0.07	−0.13		−0.07	−0.13	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 6)**		**−0.1**	**−0.14**		−0.1	−0.14		−0.1	−0.14	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 6)		−0.2	−0.3		−0.2	−0.3		−0.2	−0.3	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		−0.65	−0.75		−0.65	−0.75		−0.65	−0.75	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)	−0.7	−0.77	−0.9	−0.7	−0.77	−0.9	−0.7	−0.77	−0.9	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 6)		−0.88	−1.1		−0.88	−1.1		−0.88	−1.1	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CES}	Collector Reverse Current		0.3	15		0.3	15				nA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CES}(+125°C)	Collector Reverse Current		0.04	15		0.04	15				µA	$V_{CE} = -30$ V	$V_{BE} = 0$
I_{CES}	Collector Reverse Current								0.2	15	nA	$V_{CE} = -15$ V	$V_{BE} = 0$
I_{CES}(+125°C)	Collector Reverse Current								0.03	15	µA	$V_{CE} = -15$ V	$V_{BE} = 0$
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 6)	−40			−40			−20			Volts	$I_C = 10$ mA	$I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−40			−40			−20			Volts	$I_C = 10$ µA	$I_E = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−40			−40			−20			Volts	$I_C = 10$ µA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			−5.0			Volts	$I_C = 0$	$I_E = 10$ µA
C_{cb}	Collector to Base Capacitance		2.2	3.5		2.2	3.5		2.2	3.5	pF	$I_E = 0$	$V_{CB} = -10$ V
C_{eb}	Emitter to Base Capacitance		4.0	5.5		4.0	5.5		4.0	5.5	pF	$I_C = 0$	$V_{EB} = -0.5$ V
NF	**Noise Figure (f = 100 MHz)**		**3.5**	**6.0**		3.5	6.0		3.5	6.0	dB	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
$r_b'C_c$	Collector Base Time Constant (f = 80 MHz)		20	40		20	40		20	40	ps	$I_C = 10$ mA	$V_{CE} = -20$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 530°C/Watt (derating factor of 1.89 mW/°C) for one side; 405°C Watt (derating factor of 2.47 mW/°C) for both sides. Junction to case thermal resistance of 275°C/Watt (derating factor of 3.62 mW/°C) for one side; 160°C/Watt (deratin factor of 6.29 mW/°C) for both sides.

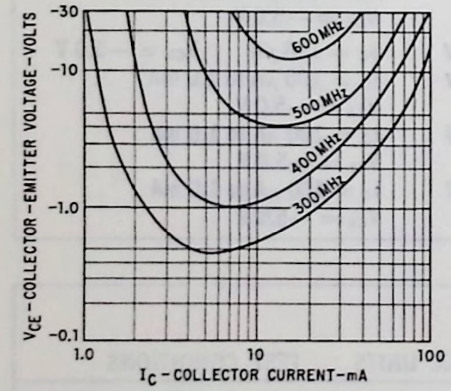
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.

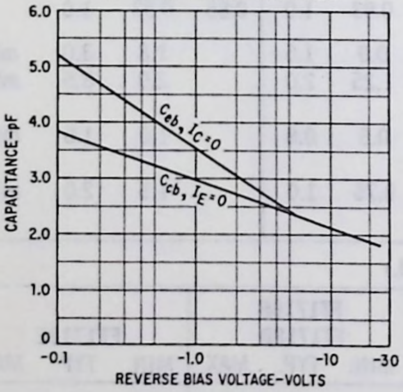
(6) Pulse Conditions: length = 300 µs; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS
(FT1718A THROUGH FT1718D)

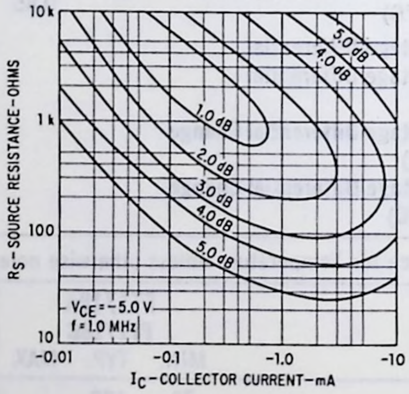
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



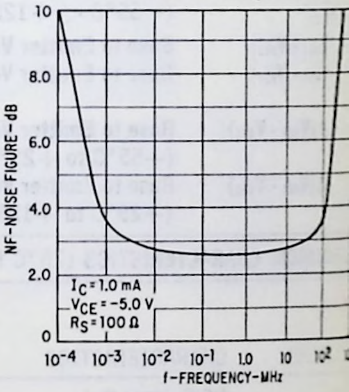
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



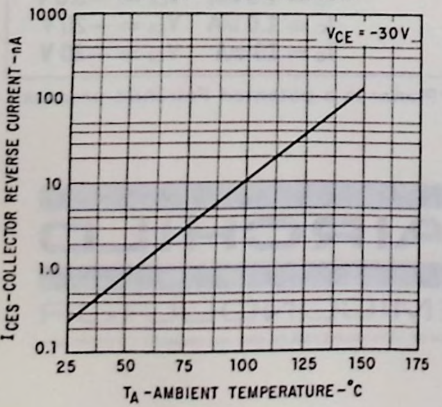
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



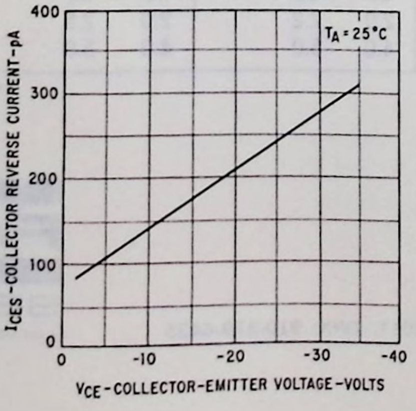
NOISE FIGURE VERSUS FREQUENCY



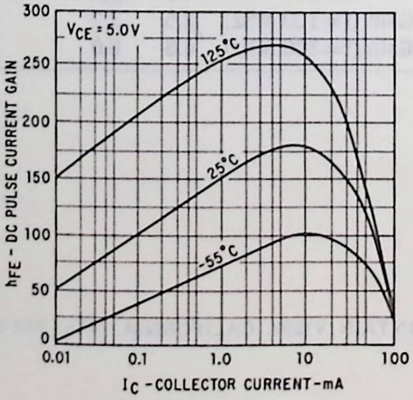
COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE



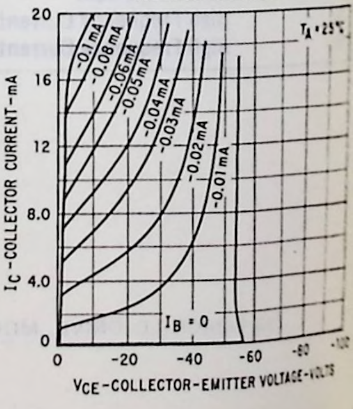
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR CHARACTERISTICS ACTIVE REGION



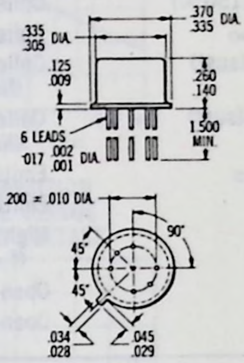
2N2060 • 2N2060A • 2N2060B

NPN DIFFERENTIAL AMPLIFIERS

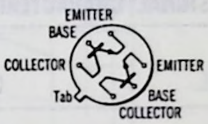
DIFFUSED SILICON PLANAR TRANSISTORS

- **TIGHT V_{BE} MATCHING -- 1.5 mV MAX. @ 100 μA to 1.0 mA**
- **h_{FE} MATCH -- 10% MAX. @ 100 μA to 1.0 mA**
- **h_{FE} MATCH -- TEMPERATURE GUARANTEE -- 15% MAX. @ 100 μA to 1.0 mA, −55°C to +125°C**
- **TIGHT V_{BE} TRACKING -- 5 μV/°C MAX. @ 100 μA, −55°C to +125°C**

PHYSICAL DIMENSIONS



CONNECTION DIAGRAM



NOTES: All dimensions in inches
Leads are gold-plated kovar
All leads electrically isolated
Weight: 1.32 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, No Time Limit)	+300°C Maximum

Maximum Power Dissipation

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	1.5 Watts	3.0 Watts
at 100°C Case Temperature [Notes 2 and 3]	0.86 Watt	1.7 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.5 Watt	0.6 Watt

Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	100 Volts
V_{CER}	Collector to Emitter Voltage (Note 4)	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts
I_C	Collector Current	500 mA
$V_{C1\,C2}$	Collector$_1$ to Collector$_2$ Voltage	±200 Volts

MATCHING CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N2060 MIN.	2N2060 MAX.	2N2060A MIN.	2N2060A MAX.	2N2060B MIN.	2N2060B MAX.	UNITS	TEST CONDITIONS
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5)	**0.9**	**1.0**	**0.9**	**1.0**	**0.9**	**1.0**		**I_C = 100 μA to 1.0 mA V_{CE} = 5.0 V**
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5) **(T_A = −55°C to +125°C)**					**0.85**	**1.0**		**I_C = 100 μA to 1.0 mA V_{CE} = 5.0 V**
$\lvert V_{BE1} - V_{BE2}\rvert$	Base-Emitter Voltage Differential		5.0		3.0		1.5	mV	I_C = 100 μA V_{CE} = 5.0 V
$\lvert V_{BE1} - V_{BE2}\rvert$	Base-Emitter Voltage Differential		5.0		5.0		1.5	mV	I_C = 1.0 mA V_{CE} = 5.0 V
$\lvert V_{BE1} - V_{BE2}\rvert$	**Base-Emitter Voltage Differential**						**1.5**	**mV**	**I_C = 100 μA to 1.0 mA V_{CE} = 5.0 V**
$\lvert\Delta (V_{BE1} - V_{BE2})\rvert$	**Base-Emitter Voltage Differential Change (T_A = 25°C to +125°C)**		1.0		0.5		**0.5**	**mV**	**I_C = 100 μA** V_{CE} = 5.0 V
$\lvert\Delta (V_{BE1} - V_{BE2})\rvert$	**Base-Emitter Voltage Differential Change (T_A = −55°C to +25°C)**		0.8		0.4		**0.4**	**mV**	**I_C = 100 μA** V_{CE} = 5.0 V
NF	Narrow Band Noise Figure (Each Transistor) (f = 1.0 kHz)		8.0		8.0		8.0	dB	I_C = 300 μA V_{CE} = 10 V P.B.W. = 200 Hz Rg = 510Ω
NF	Broad Band Noise Figure (Each Transistor) (Note 7)		8.0		8.0		8.0	dB	I_C = 300 μA V_{CE} = 10 V BROADBAND Rg = 1.0 kΩ

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FAIRCHILD
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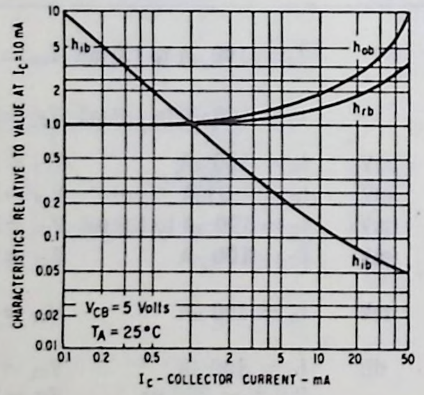
ELECTRICAL CHARACTERISTICS FOR EACH TRANSISTOR (25°C Free Air Temperature unless otherwise noted)

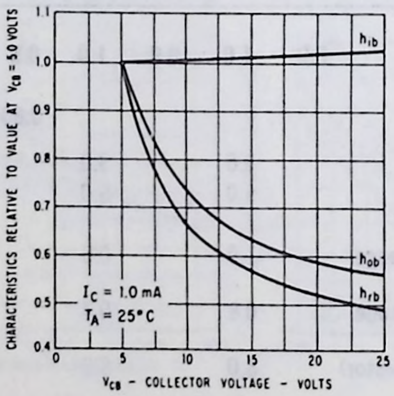
SYMBOL	CHARACTERISTIC	2N2060 MIN.	2N2060 MAX.	2N2060A MIN.	2N2060A MAX.	2N2060B MIN.	2N2060B MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 6)	50	150	50	150	50	150		$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	40	120	40	120	40	120		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	30	90	30	90	30	90		$I_C = 100\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	25	75	25	75	25	75		$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 6)		0.9		0.9		0.9	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 6)		1.2		0.6		0.6	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CBO}	Collector Cutoff Current		2.0		2.0		2.0	nA	$I_E = 0$	$V_{CB} = 80$ V
$I_{CBO}(150°C)$	Collector Cutoff Current		10		10		10	μA	$I_E = 0$	$V_{CB} = 80$ V
BV_{CBO}	Collector to Base Breakdown Voltage	100		100		100			$I_C = 100\ \mu A$	$I_E = 0$
$V_{CER}(sust)$	Collector to Emitter Sustaining Voltage (Notes 4 and 6)	80		80		80		Volts	$I_C = 100$ mA (pulsed)	$R_{BE} \leq 10\ \Omega$
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Notes 4 and 6)	60		60		60		Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter Breakdown Voltage	7.0		7.0		7.0		Volts	$I_C = 0$	$I_E = 100\ \mu A$
I_{EBO}	Emitter Cutoff Current		2.0		2.0		2.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
h_{fe}	High Freqency Current Gain (f = 20 MHz)	3.0		3.0		3.0	8.0		$I_C = 50$ mA	$V_{CE} = 10$ V
C_{obo}	Open-Circuit Output Capacitance		15		15		15	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{ibo}	Open-Circuit Input Capacitance		85		85		85	pF	$I_C = 0$	$V_{EB} = 0.5$ V

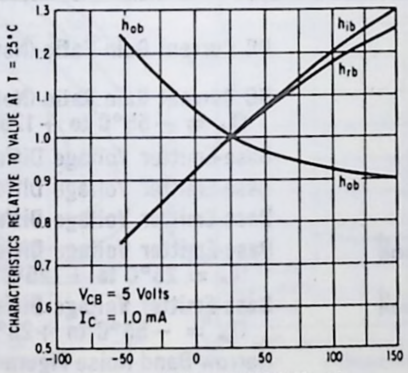
SMALL SIGNAL CHARACTERISTICS FOR EACH TRANSISTOR (f = 1 kHz)

SYMBOL	CHARACTERISTIC	2N2060 MIN.	2N2060 MAX.	2N2060A MIN.	2N2060A MAX.	2N2060B MIN.	2N2060B MAX.	UNITS	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain	50	150	50	150	50	150		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ie}	Input Resistance	1.0	4.0	1.0	4.0	1.0	4.0	kOhms	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance	4.0	16	4.0	16	4.0	16	μmhos	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance	20	30	20	30	20	30	Ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{re}	Voltage Feedback Ratio						10	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

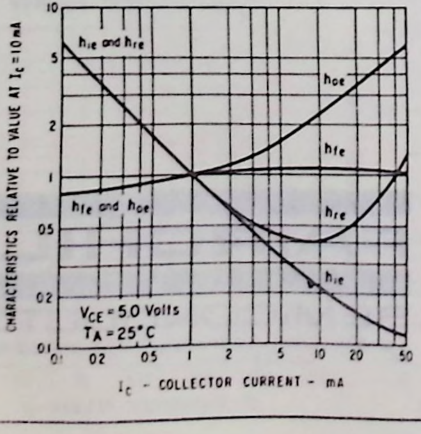
TYPICAL COMMON BASE CHARACTERISTICS

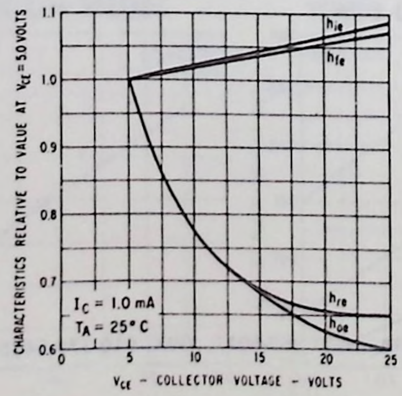


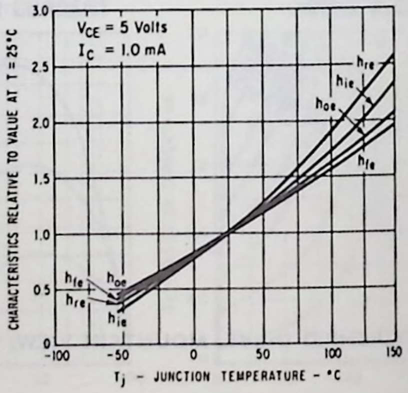




TYPICAL COMMON EMITTER CHARACTERISTICS

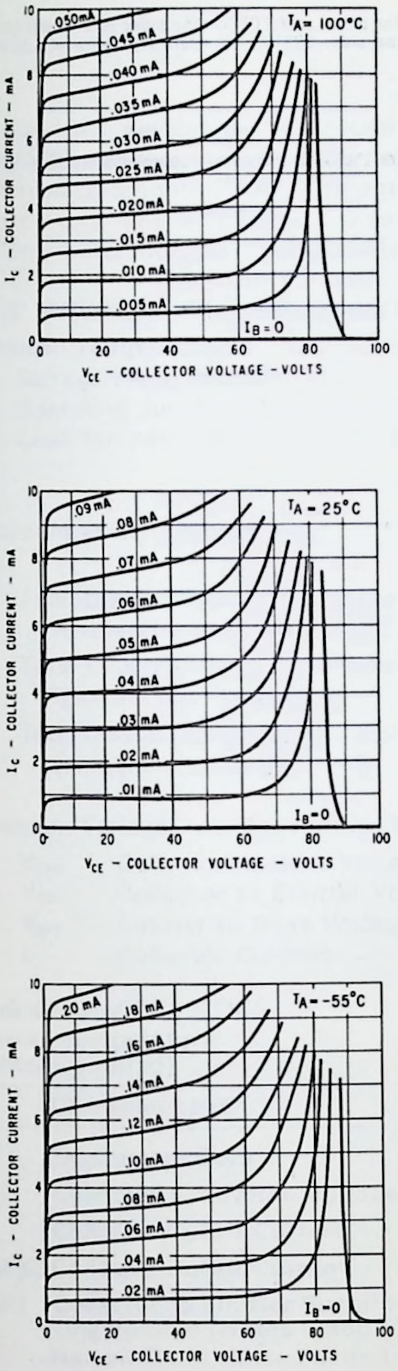




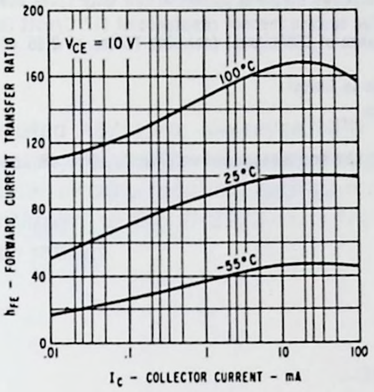


TYPICAL ELECTRICAL CHARACTERISTICS

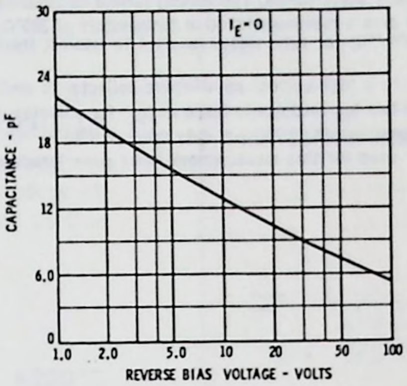
HIGH VOLTAGE COLLECTOR CHARACTERISTICS*



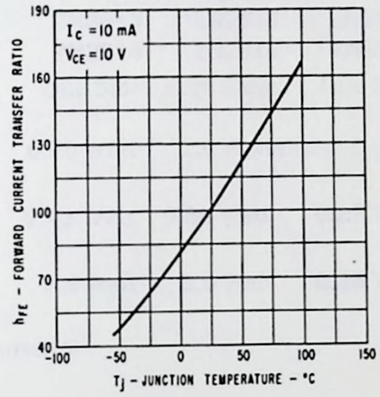
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



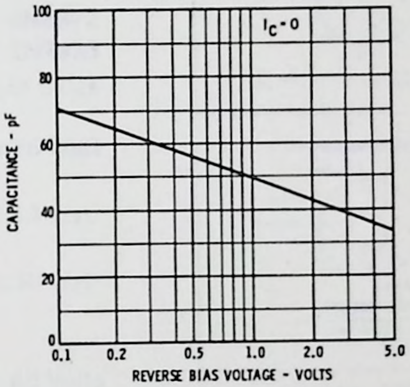
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



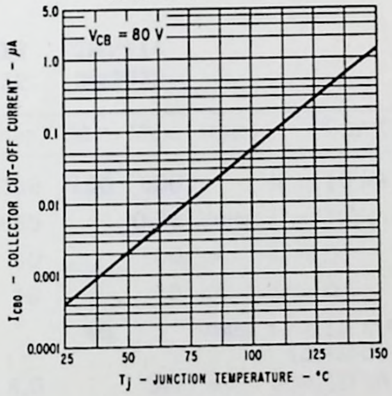
DC PULSE CURRENT GAIN VERSUS TEMPERATURE



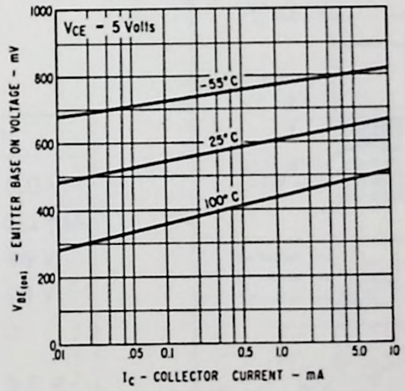
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



COLLECTOR CUTOFF CURRENT VERSUS TEMPERATURE

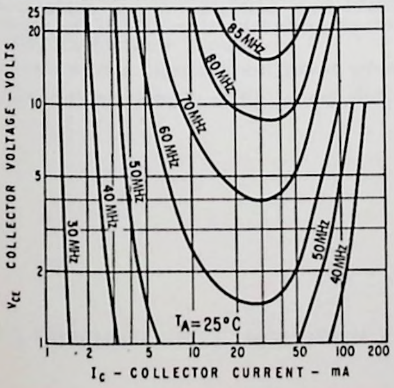


EMITTER-BASE ON VOLTAGE VERSUS COLLECTOR CURRENT

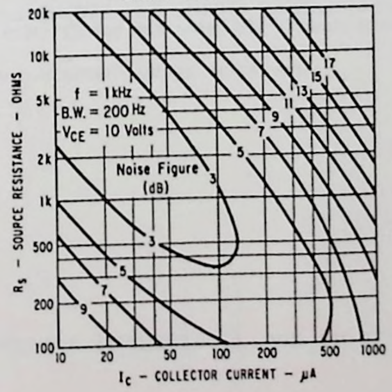


* Single family characteristics on Transistor Curve Tracer

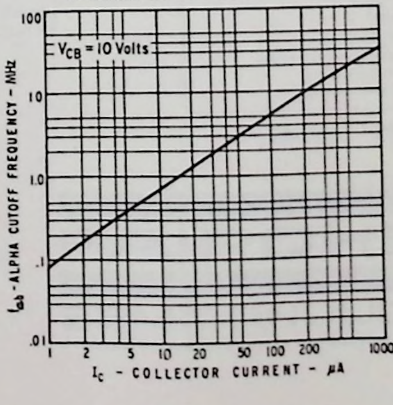
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



CONTOURS OF NARROW BAND NOISE FIGURE



ALPHA CUTOFF FREQUENCY VERSUS COLLECTOR CURRENT



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 117°C/watt (derating factor of 8.6 mW/°C) for one side; 58.3°C/watt (derating fa tor of 17.2 mW/°C) for both sides. Junction to ambient thermal resistance of 350°C/watt (derating factor of 2.86 mW/°C) for one side; 292°C/watt (derating factor of 3.43 mW/°C) f both sides.

(4) Rating refers to a high-current point where collector to emitter voltage is lowest.

(5) Lowest of the two h_{FE} readings is taken as h_{FE_1} for purposes of this ratio.

(6) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(7) The amplifier used for this measurement has a power bandwidth of 15.7 kHz and a response which rolls off 6 dB per octave where the 3 dB points are approximately at 25 Hz and 10 k

2N2913 • 2N2914 • 2N2972 • 2N2973

NPN LOW LEVEL, LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

These six-terminal devices each contain two isolated high-gain, low-noise NPN double-diffused silicon PLANAR transistors in one hermetically sealed enclosure. They are designed for use in high performance amplifier and differential amplifier circuits requiring high-gain and low-noise at low current levels. The 2N2913 is an exact counterpart to the 2N2972 as is the 2N2914 to the 2N2973, only differences are packages and power ratings.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	300°C Maximum

Maximum Power Dissipation	2N2913 2N2914 One Side	2N2913 2N2914 Both Sides	2N2972 2N2973 One Side	2N2972 2N2973 Both Sides
Total Dissipation at 25°C Case Temperature [Notes 2 & 3]	0.75 Watt	1.5 Watts	0.5 Watt	0.75 Watt
Total Dissipation at 100°C Case Temperature [Notes 2 & 3]	0.43 Watt	0.86 Watt	0.29 Watt	0.43 Watt
Total Dissipation at 25°C Ambient Temperature [Notes 2 & 3]	0.3 Watt	0.6 Watt	0.25 Watt	0.30 Watt

Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	45 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	45 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	30 mA

ATCHING CHARACTERISTICS

5°C free air temperature
less otherwise noted)

ymbol	Characteristics	2N2913 2N2972 Min.	Max.	2N2914 2N2973 Min.	Max.	Units	Test Conditions	
FE	DC Current Gain	60	240	150	600		$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
CE(sat)	Collector Saturation Voltage		0.35		0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
BO	Collector Cutoff Current		10		10	nA	$I_E = 0$	$V_{CB} = 45$ V
BO (150°C)	Collector Cutoff Current		10		10	μA	$I_E = 0$	$V_{CB} = 45$ V
CEO (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	45		45		Volts	$I_C = 10$ mA' (pulsed)	$I_B = 0$
F	Narrow Band Noise Figure [Note 6]		4.0		3.0	dB	$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
F	Wide Band Noise Figure [Note 7]		4.0		3.0	dB	$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V

*Planar is a patented Fairchild process.

TES:

) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

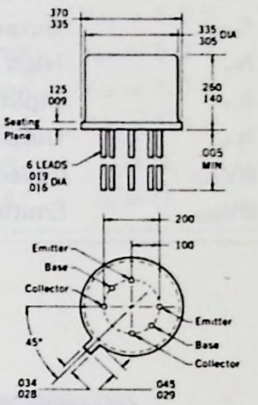
) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

) These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 584°C/watt (derating factor of 1.71 mW/°C) for one side; 292°C/watt (derating factor of 3.42 mW/°C) for both sides for the 2N2913 and 2N2914. For the 2N2972 and 2N2973 junction-to-ambient thermal resistance of 700°C/watt (derating factor of 1.43 mW/°C) for one side; 584°C/watt (derating factor of 1.71 mW/°C) for both sides.

) Rating refers to a high current point where collector-to-emitter voltage is lowest.

) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

PHYSICAL DIMENSIONS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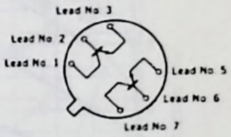
335
335
305 DIA
125
009
Seating Plane
260
140
6 LEADS
019
016 DIA
005 MIN
200
100
Emitter
Base
Collector
45°
Emitter
Base
Collector
034
028
045
029

CONNECTION DIAGRAM

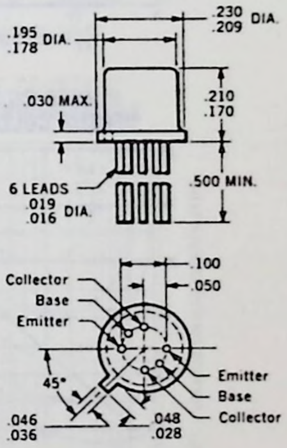

Lead No 3
Lead No 2
Lead No 1
Lead No 5
Lead No 6
Lead No 7

BOTTOM VIEW

NOTES All dimensions in inches
Leads are gold plated kovar
Package weight is 1 23 grams

2N2913 2N2914

PHYSICAL DIMENSIONS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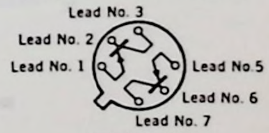
.195
.178 DIA.
.030 MAX.
.210
.170
6 LEADS
.019
.016 DIA.
.500 MIN.
.100
.050
Collector
Base
Emitter
45°
Emitter
Base
Collector
.046
.036
.048
.028

CONNECTION DIAGRAM


Lead No. 3
Lead No. 2
Lead No. 1
Lead No.5
Lead No. 6
Lead No. 7

BOTTOM VIEW

NOTES All dimensions in inches
Leads are gold plated kovar
Package weight is 0.62 gram

2N2972 2N2973

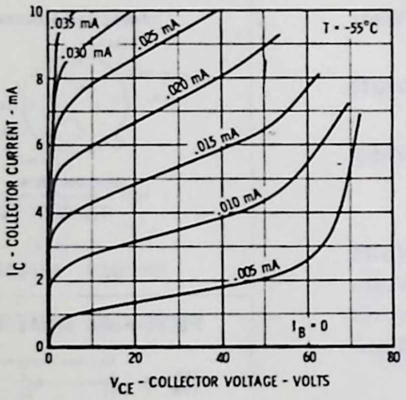
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

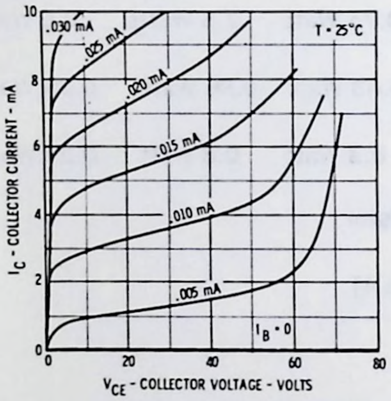
SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	150			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	100			$I_C = 100\ \mu A$	$V_{CE} = 5.0$ V
h_{FE} (−55°C)	DC Current Gain	15			$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
V_{BE} (on)	Emitter-Base On Voltage		0.7	Volts	$I_C = 0.1$ mA	$V_{CE} = 5.0$ V
I_{CEO}	Collector Cutoff Current		2.0	nA	$I_B = 0$	$V_{CE} = 5.0$ V
I_{EBO}	Emitter Cutoff Current		2.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{obo}	Output Capacitance		6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0			$I_C = 0.5$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance (f = 1 kHz)	25	32	Ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance (f = 1 kHz)		1.0	μmhos	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	45		Volts	$I_C = 10\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		Volts	$I_E = 10\ \mu A$	$I_C = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

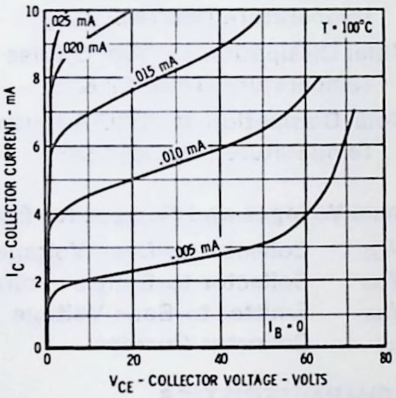
COLLECTOR CHARACTERISTICS



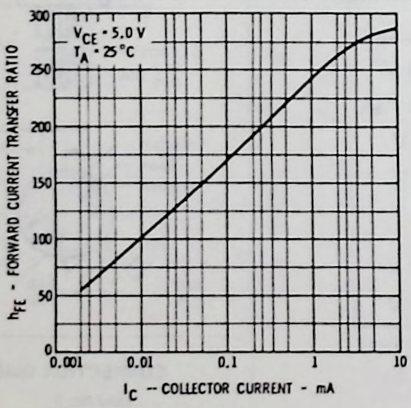
COLLECTOR CHARACTERISTICS



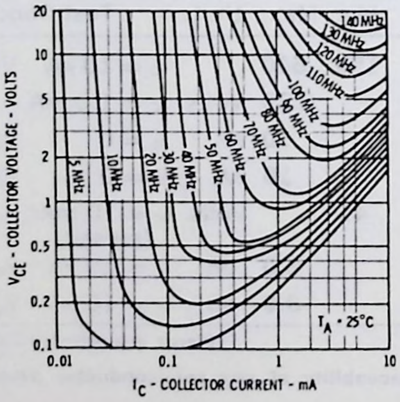
COLLECTOR CHARACTERISTICS



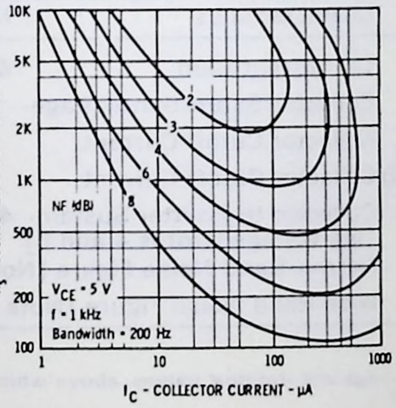
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



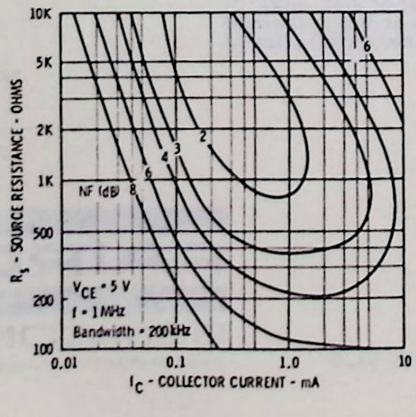
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



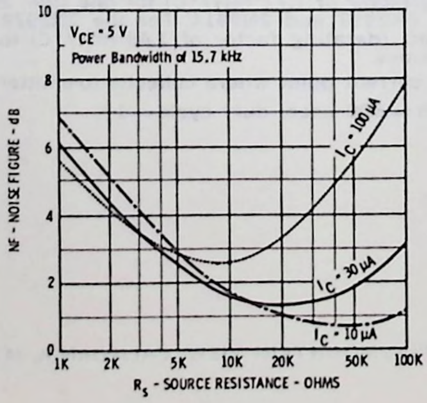
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



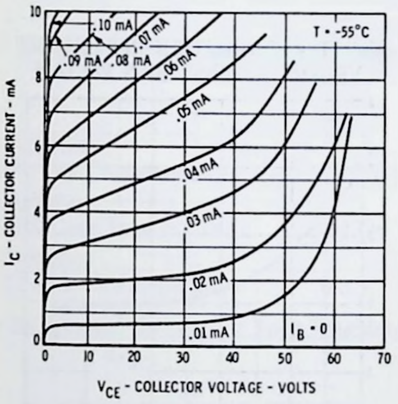
FAIRCHILD TRANSISTORS 2N2913 • 2N2914 • 2N2972 • 2N2973

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

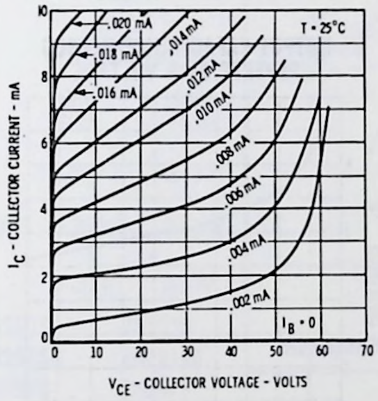
SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	300			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	225			$I_C = 100$ μA	$V_{CE} = 5.0$ V
h_{FE} (−55°C)	DC Current Gain	30			$I_C = 10$ μA	$V_{CE} = 5.0$ V
V_{BE} (on)	Emitter-Base On Voltage		0.7	Volts	$I_C = 0.1$ mA	$V_{CE} = 5.0$ V
I_{CEO}	Collector Cutoff Current		2.0	nA	$I_B = 0$	$V_{CE} = 5.0$ V
I_{EBO}	Emitter Cutoff Current		2.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{obo}	Output Capacitance		6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0			$I_C = 0.5$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance (f = 1 kHz)	25	32	Ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance (f = 1 kHz)		1.0	μmhos	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	45		Volts	$I_C = 10$ μA	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		Volts	$I_E = 10$ μA	$I_C = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

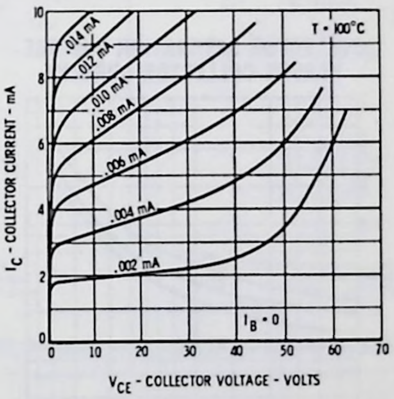
COLLECTOR CHARACTERISTICS



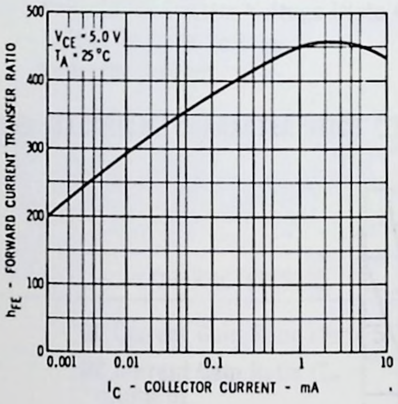
COLLECTOR CHARACTERISTICS



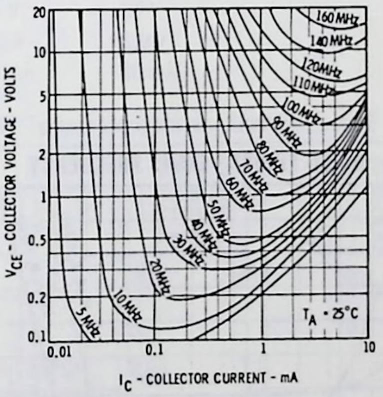
COLLECTOR CHARACTERISTICS



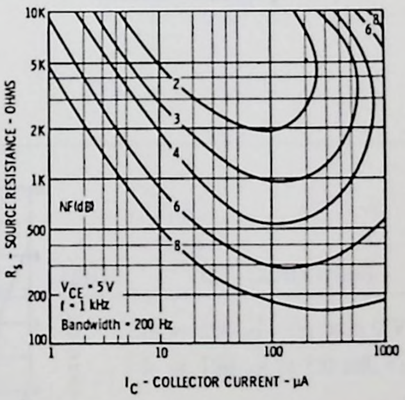
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



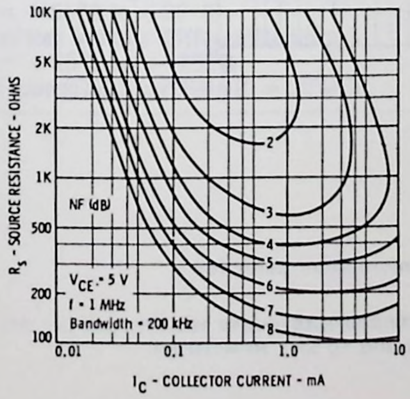
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



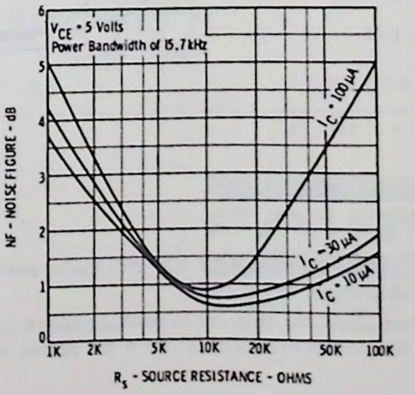
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



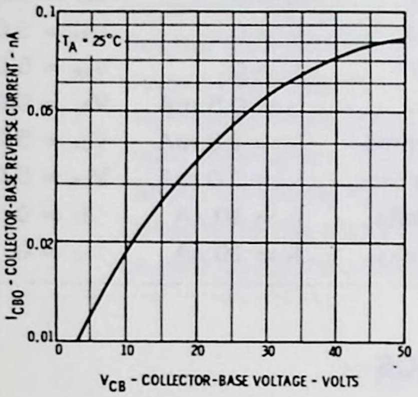
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



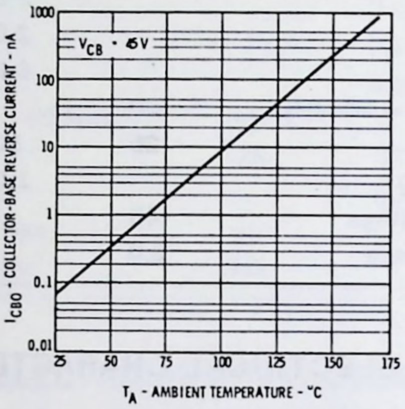
TYPICAL ELECTRICAL CHARACTERISTICS

(THESE CURVES APPLY TO ALL UNITS)

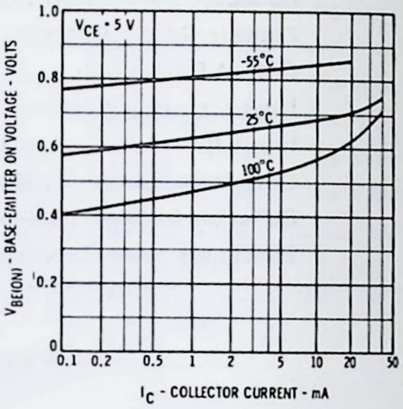
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



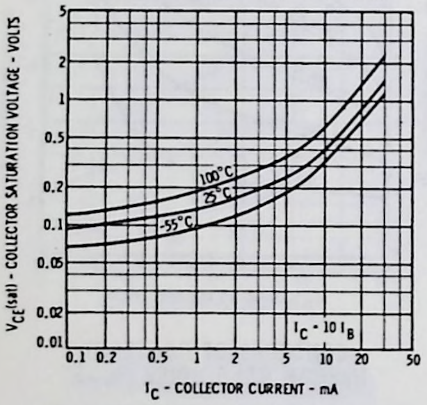
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



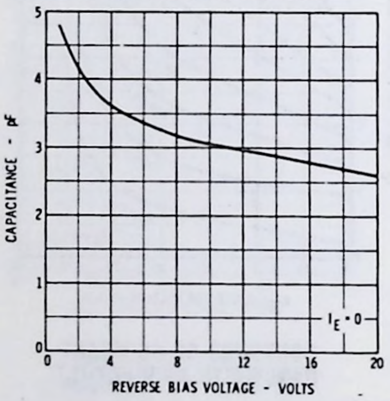
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



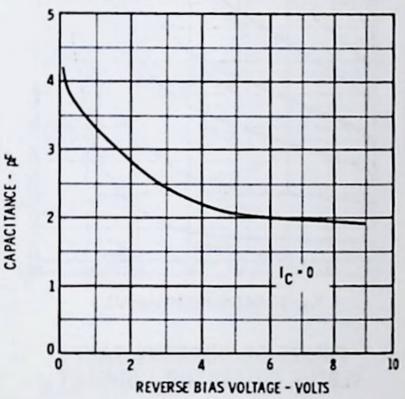
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



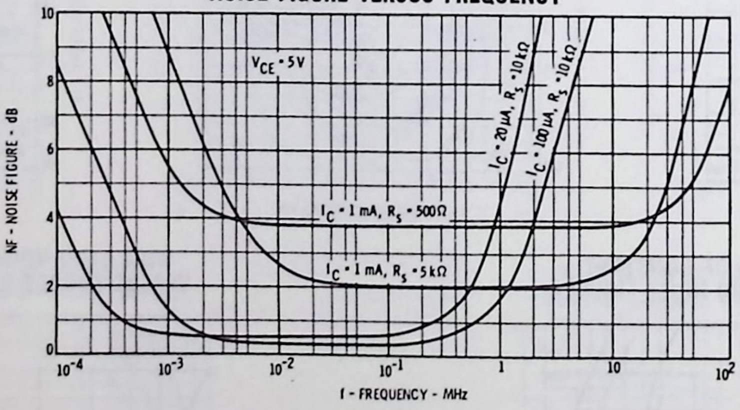
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



NOISE FIGURE VERSUS FREQUENCY



NOTES: (Continued)

(6) Frequency = 1000 Hz; Rs = 10 kΩ; 200 cycle power bandwidth. For more information send for Fairchild Publication APP-13/2.

(7) The amplifier used for this measurement has a power bandwidth of 15.7 kHz and a response which rolls off 6 dB per octave where the 3 dB points are approximately at 25 Hz and 10 kHz Rs = 10 kΩ.

2N2915/2N2915A · 2N2919/2N2919A
2N2974/FT2974 · 2N2978/FT2978
NPN LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIERS
DIFFUSED SILICON PLANAR* TRANSISTORS

FEATURES

- **HIGH BREAKDOWN -- 60 VOLT LV_{CEO}**
- **HIGH CURRENT GAIN AT LOW COLLECTOR CURRENT -- 60 MIN AT 10 μA**
- **TIGHT V_{BE} MATCHING -- 1.5 mV MAX AT 100 μA**
- **TIGHT V_{BE} TRACKING -- 5 μV/°C MAX AT 100 μA —55°C to +125°C**
- **BETA MATCH GUARANTEED OVER TEMPERATURE -- 15% MAX FROM 100 μA to 1.0 mA, —55°C to +125°C**
- **LOW NOISE -- 4.0 dB MAX AT 1 kHz**

ABSOLUTE MAXIMUM RATINGS [Note 1]

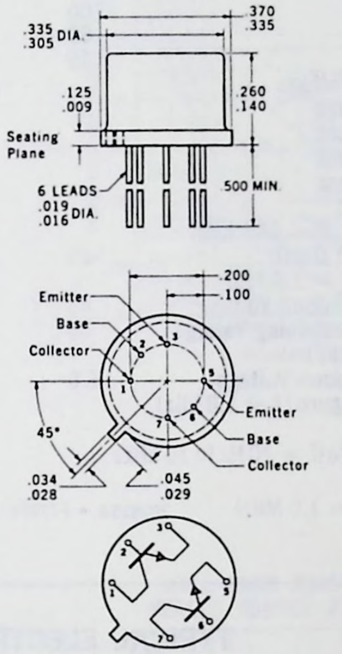
Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 seconds time limit)	300°C Maximum

Maximum Power Dissipation [Notes 2 and 3]	2N2915 **2N2915A** 2N2919 **2N2919A**		2N2974 **FT2974** 2N2978 **FT2978**	
	One Side	Both Sides	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	0.75 W	1.5 W	0.5 W	0.75 W
Total Dissipation at 100°C Case Temperature	0.43 W	0.86 W	0.29 W	0.43 W
Total Dissipation at 25°C Ambient Temperature	0.3 W	0.5 W	0.25 W	0.3 W

Maximum Voltages and Current for Each Transistor		2N2915 **2N2915A** 2N2974 **FT2974**	2N2919 **2N2919A** 2N2978 **FT2978**
V_{CBO}	Collector to Base Voltage	45 V	60 V
V_{CEO}	Collector to Emitter Voltage [Note 4]	45 V	60 V
V_{EBO}	Emitter to Base Voltage	6.0 V	6.0 V
I_C	Collector Current	30 mA	30 mA

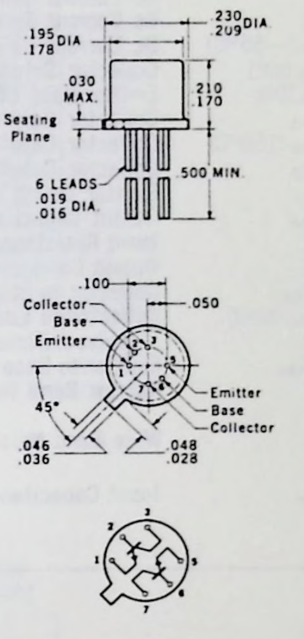
PHYSICAL DIMENSIONS


.335
.305 DIA.
.370
.335
.125
.009
.260
.140
Seating Plane
6 LEADS
.019
.016 DIA.
.500 MIN
.200
.100
Emitter
Base
Collector
1
2
3
5
6
7
45°
Emitter
Base
Collector
.034
.028
.045
.029
1
2
3
5
6
7

NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 1.27 grams

2N2915/2N2915A · 2N2919/2N2919A

PHYSICAL DIMENSIONS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.170
Seating Plane
6 LEADS
.019
.016 DIA.
.500 MIN.
.100
.050
Collector
Base
Emitter
1
2
3
5
6
7
45°
Emitter
Base
Collector
.046
.036
.048
.028
1
2
3
5
6
7

NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 0.59 gram

2N2974/FT2974 · 2N2978/FT2978

ATCHING AND ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

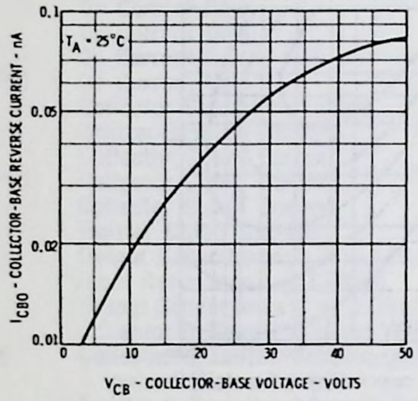
		2N2915A 2N2919A FT2974 FT2978		2N2915 2N2919 2N2974 2N2978			
SYMBOL	CHARACTERISTIC	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio [Note 5]	0.9	1.0	0.9	1.0		$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio ($T_A = -55°C$ to $+125°C$) [Note 5]**	**0.85**	**1.0**				**$I_C = 100\ \mu A$ to $1.0\ mA$, $V_{CE} = 5.0\ V$**
$\lvert V_{BE1}-V_{BE2}\rvert$	Base-Emitter Voltage Differential [Note 6]		2.0		5.0	mV	$I_C = 10\ \mu A$ to $1.0\ mA$, $V_{CE} = 5.0\ V$
$\lvert V_{BE1}-V_{BE2}\rvert$	**Base-Emitter Voltage Differential [Note 6]**		**1.5**		3.0	**mV**	$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$
$\lvert\Delta(V_{BE1}-V_{BE2})\rvert$	**Base-Emitter Voltage Differential Change ($T_A = -55°C$ to $+25°C$)**		**0.4** **(5 μV/°C)**		0.8 (10 μV/°C)	**mV**	$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$
$\lvert\Delta(V_{BE1}-V_{BE2})\rvert$	**Base-Emitter Voltage Differential Change** ($T_A = +25°C$ to $+125°C$)		**0.5** **(5 μV/°C)**		1.0 (10 μV/°C)	**mV**	$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0	8.0	3.0			$I_C = 0.5\ mA$, $V_{CE} = 5.0\ V$

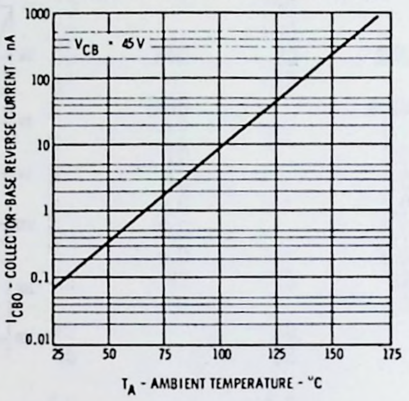
* Planar is a patented Fairchild process.

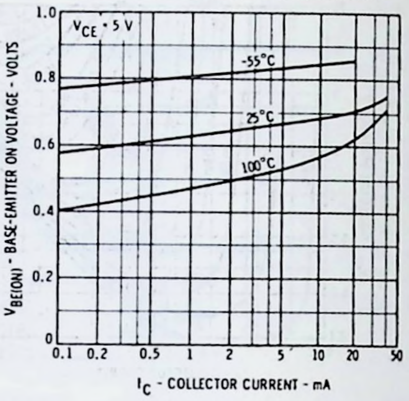
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

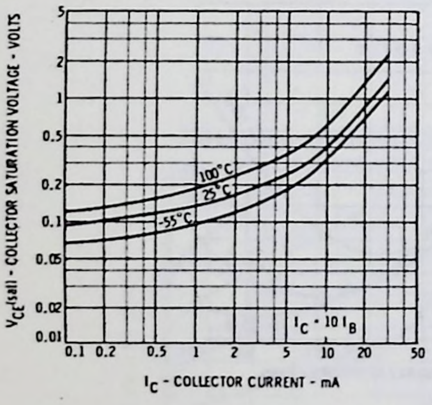
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

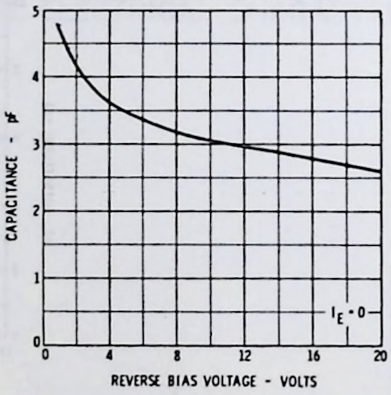
TYPICAL ELECTRICAL CHARACTERISTICS

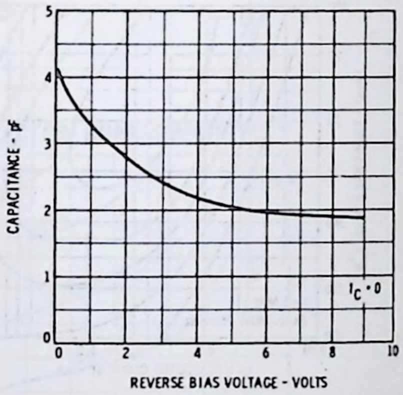

COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE


COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE


BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT


COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT


OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE


EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/watt (derating factor of 1.71 mW/°C) for one side; 350°C/watt (derating factor of 2.86 mW/°C) for both sides for the 2N2915, 2N2915A, 2N2919, and 2N2919A. For the 2N2974, FT2974, 2N2978, and FT2978, junction to ambient thermal resista of 700°C/watt (derating factor of 1.43 mW/°C) for one side; 584°C/watt (derating factor of 1.71 mW/°C) for both sides.

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.

(6) Absolute values.

(7) Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N2916/2N2916A · 2N2920/2N2920A
2N2975/FT2975 · 2N2979/FT2979

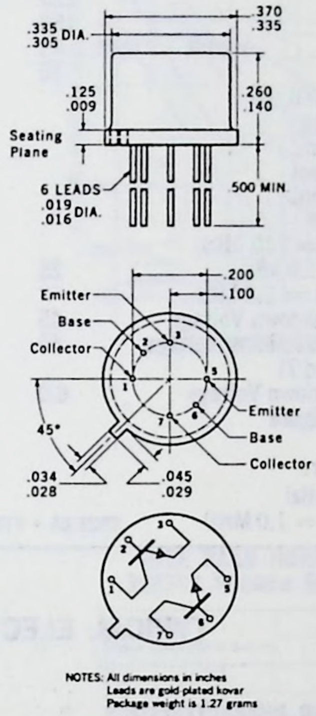
NPN LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **HIGH BREAKDOWN — 60 VOLT LV_{CEO}**
- **HIGH CURRENT GAIN AT LOW COLLECTOR CURRENT — 150 MIN AT 10 μA**
- **TIGHT V_{BE} MATCHING — 1.5 mV MAX AT 100 μA**
- **TIGHT V_{BE} TRACKING — 5 μV/°C MAX AT 100 μA −55°C to +125°C**
- **BETA MATCH GUARANTEED OVER TEMPERATURE — 15% MAX FROM 100 μA to 1.0 mA, −55°C to +125°C**
- **LOW NOISE — 3.0 dB MAX AT 1 kHz**

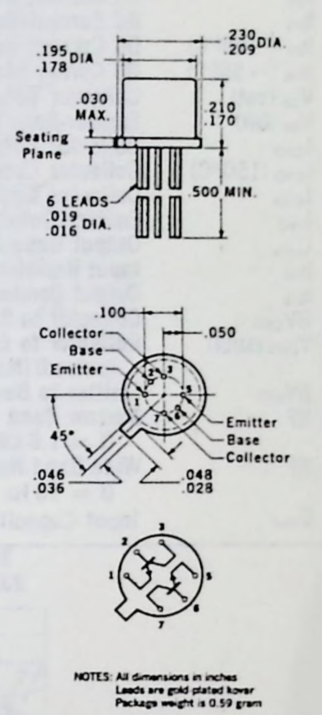
*Planar is a patented Fairchild process.

PHYSICAL DIMENSIONS


.370
.335
.335
.305 DIA.
.125
.009
.260
.140
Seating Plane
6 LEADS
.019
.016 DIA.
.500 MIN
.200
.100
Emitter
Base
Collector
Emitter
Base
Collector
45°
.034
.028
.045
.029
1
2
3
5
6
7
NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 1.27 grams

2N2916/2N2916A · 2N2920/2N2920A

PHYSICAL DIMENSIONS


.230
.209 DIA.
.195
.178 DIA
.030
MAX.
.210
.170
Seating Plane
6 LEADS
.019
.016 DIA.
.500 MIN.
.100
.050
Collector
Base
Emitter
Emitter
Base
Collector
45°
.046
.036
.048
.028
1
2
3
5
6
7
NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 0.59 gram

2N2975/FT2975 · 2N2979/FT2979

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 seconds time limit)	300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)	2N2916 **2N2916A** 2N2920 **2N2920A**		2N2975 **FT2975** 2N2979 **FT2979**	
	One Side	Both Sides	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	0.75 W	1.5 W	0.5 W	0.75 W
Total Dissipation at 100°C Case Temperature	0.43 W	0.86 W	0.29 W	0.43 W
Total Dissipation at 25°C Ambient Temperature	0.3 W	0.5 W	0.25 W	0.3 W

Maximum Voltages and Current for Each Transistor		2N2916 **2N2916A** 2N2975 **FT2975**	2N2920 **2N2920A** 2N2979 **FT2979**
V_{CBO}	Collector to Base Voltage	45 V	60 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 V	60 V
V_{EBO}	Emitter to Base Voltage	6.0 V	6.0 V
I_C	Collector Current	30 mA	30 mA

MATCHING AND ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N2916A **2N2920A** **FT2975** **FT2979**		2N2916 2N2920 2N2975 2N2979			
SYMBOL	CHARACTERISTIC	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio (Note 5)	0.9	1.0	0.9	1.0		$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio ($T_A = -55°C$ to $+125°C$)** [Note 5]	**0.85**	**1.0**				**$I_C = 100\ \mu A$ to $1.0\ mA$, $V_{CE} = 5.0\ V$**
$\lvert V_{BE1}-V_{BE2}\rvert$	Base-Emitter Voltage Differential (Note 6)		2.0		5.0	mV	$I_C = 10\ \mu A$ to $1.0\ mA$, $V_{CE} = 5.0\ V$
$\lvert V_{BE1}-V_{BE2}\rvert$	**Base-Emitter Voltage Differential** (Note 6)		**1.5**		3.0	**mV**	**$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$**
$\Delta(V_{BE1}-V_{BE2})$	**Base-Emitter Voltage Differential Change ($T_A = -55°C$ to $+25°C$)**		**0.4** **(5 μV/°C)**		0.8 (10 μV/°C)	**mV**	**$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$**
$\Delta(V_{BE1}-V_{BE2})$	**Base-Emitter Voltage Differential Change** ($T_A = +25°C$ to $+125°C$)		**0.5** **(5 μV/°C)**		1.0 (10 μV/°C)	**mV**	$I_C = 100\ \mu A$, $V_{CE} = 5.0\ V$
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0	8.0	3.0			$I_C = 0.5\ mA$, $V_{CE} = 5.0\ V$

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

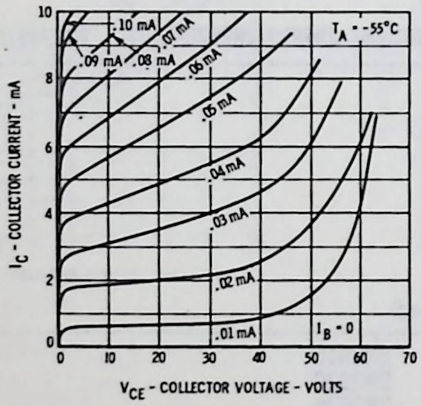
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

(FOR LOWER CURRENT GAIN DEVICES REFER TO 2N2915 DATA SHEET)

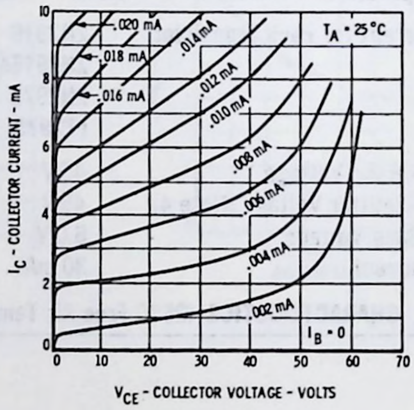
		2N2916 **2N2916A** 2N2975 **FT2975**		2N2920 **2N2920A** 2N2979 **FT2979**				
SYMBOL	CHARACTERISTIC	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	300		300			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	225		225			$I_C = 100\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	**DC Current Gain**	**150**	**600**	**150**	**600**		**$I_C = 10\ \mu A$**	$V_{CE} = 5.0$ V
h_{FE} (−55°C)	DC Current Gain 2N2916A • FT2975	40		40			$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
h_{FE} (−55°C)	DC Current Gain	30					$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
V_{CE} (sat)	Collector Saturation Voltage		0.35		0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ m
V_{BE} (ON)	Emitter-Base ON Voltage		0.7		0.7	Volts	$I_C = 0.1$ mA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Cutoff Current		10		2.0	nA	$I_E = 0$	$V_{CB} = 45$ V
I_{CBO} (150°C)	Collector Cutoff Current		10		10	μA	$I_E = 0$	$V_{CB} = 45$ V
I_{CEO}	Collector Cutoff Current		2.0		2.0	nA	$I_B = 0$	$V_{CE} = 5.0$ V
I_{EBO}	Emitter Cutoff Current		2.0		2.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{obo}	Output Capacitance (f = 140 kHz)		6.0		6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
h_{ib}	Input Resistance (f = 1.0 kHz)	25	32	25	32	Ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance (f = 1.0 kHz)		1.0		1.0	μmhos	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	45		60		Volts	$I_C = 10\ \mu A$	$I_E = 0$
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** (pulsed) [Notes 4 and 7]	45		**60**		**Volts**	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	$I_E = 10\ \mu A$	$I_C = 0$
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**		**3.0**		**3.0**	**dB**	$I_C = 10\ \mu A$ PBW = 200 Hz	$V_{CE} = 5.0$ V $R_S = 10$ kΩ
NF	Wide Band Noise Figure (f = 10 Hz to 10 kHz)		3.0		3.0	dB	$I_C = 10\ \mu A$ PBW = 15.7 kHz	$V_{CE} = 5.0$ V $R_S = 10$ kΩ
C_{ibo}	Input Capacitance (f = 1.0 MHz)		2N2916A • FT2975 10		2N2920A • FT2979 10	pF	$I_C = 0$	$V_{EB} = 0.5$ V

TYPICAL ELECTRICAL CHARACTERISTICS

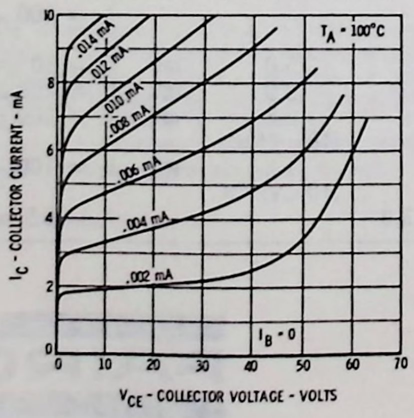
COLLECTOR CHARACTERISTICS



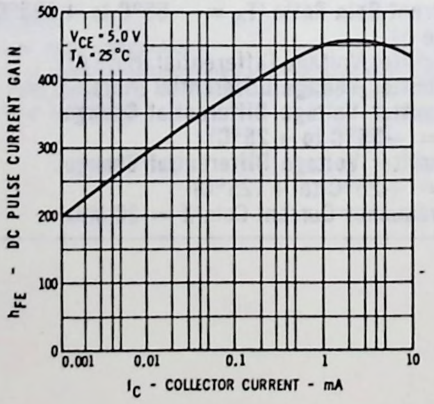
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS

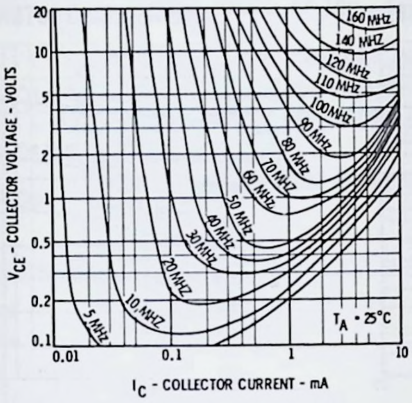


DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

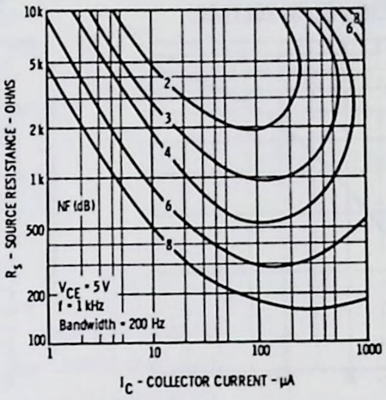


TYPICAL ELECTRICAL CHARACTERISTICS

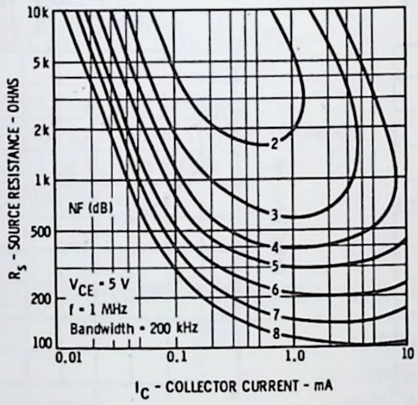
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



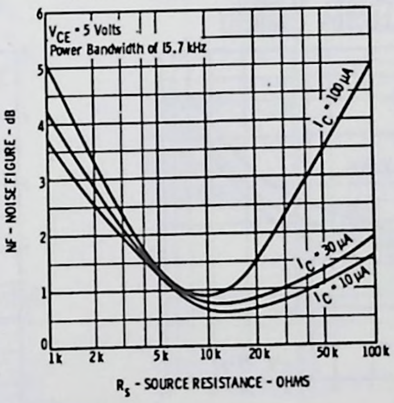
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



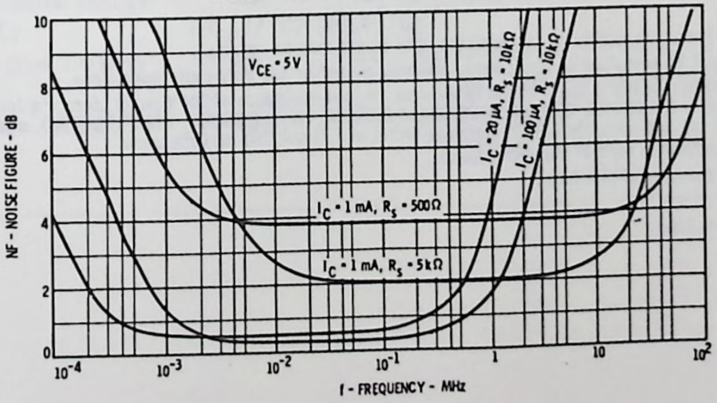
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE

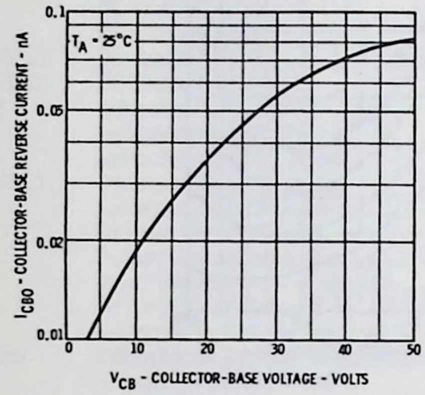


NOISE FIGURE VERSUS FREQUENCY

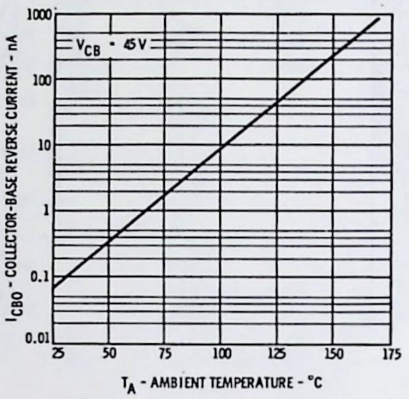


TYPICAL ELECTRICAL CHARACTERISTICS

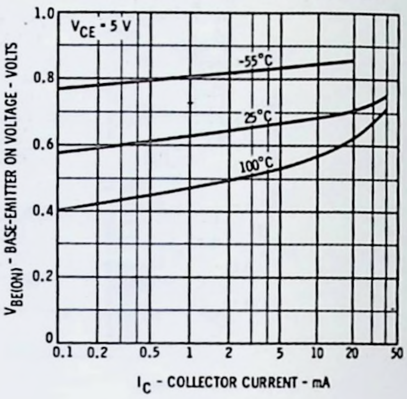
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



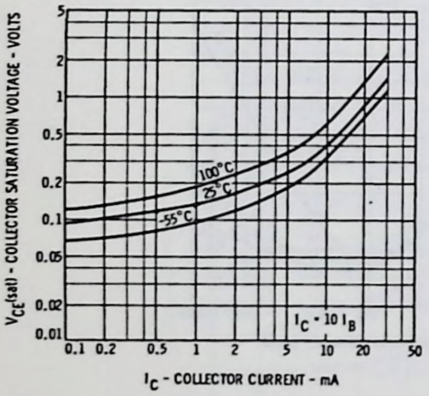
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



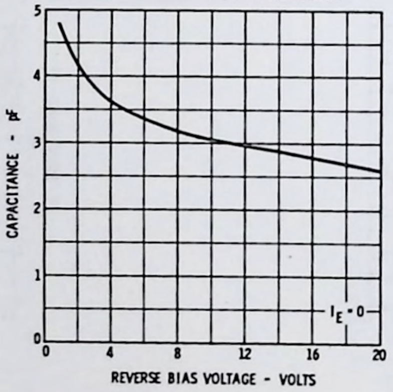
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



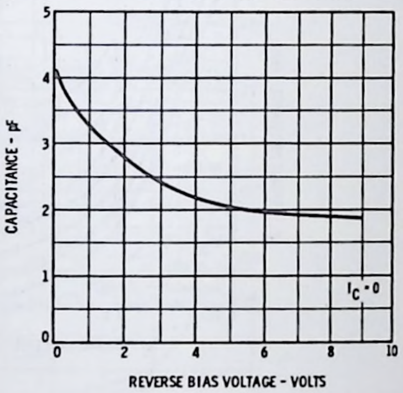
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/watt (derating factor of 1.71 mW/°C) for one side; 350°C/watt (derating factor of 2.86 mW/°C) for both sides for the 2N2916, 2N2916A, 2N2920, and 2N2920A. For the 2N2975, FT2975, 2N2979, and FT2979, junction to ambient thermal resistance of 700°C/watt (derating factor of 1.43 mW/°C) for one side; 584°C/watt (derating factor of 1.71 mW/°C) for both sides.

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.

(6) Absolute values.

(7) Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N2917 • 2N2918 • 2N2976 • 2N2977

NPN LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **BETA RATIO . . . . $\frac{h_{FE1}}{h_{FE2}}$ = 20% (MAX) AT 100 μA**
- **V_{BE} MATCH . . . . $|V_{BE1}\text{-}V_{BE2}|$ = 5.0 mV (MAX) AT 100 μA**
  $|V_{BE1}\text{-}V_{BE2}|$ = 10 mV (MAX) FROM 10 μA TO 1.0 mA
- **V_{BE} TRACKING . . . . ΔV_{BE} = 20 μV/°C (MAX) AT 100 μA**
- **BREAKDOWN VOLTAGE . . . LV_{CEO} = 45 V (MIN)**
- **LOW NOISE . . . . NF = 3.0 dB (MAX) WIDE BAND AND AT 1.0 kHz**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)	**2N2917 2N2918 ONE SIDE**	**2N2917 2N2918 BOTH SIDES**	**2N2976 2N2977 ONE SIDE**	**2N2976 2N2977 BOTH SIDES**
Total Dissipation at 25°C Case Temperature	0.75 Watt	1.5 Watts	0.5 Watt	0.75 Watt
at 100°C Case Temperature	0.43 Watt	0.86 Watt	0.29 Watt	0.43 Watt
at 25°C Ambient Temperature	0.3 Watt	0.6 Watt	0.25 Watt	0.30 Watt

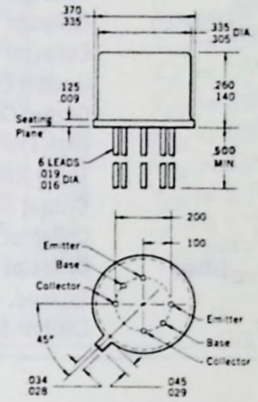
Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	30 mA

MATCHING AND ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

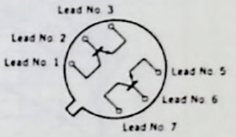
		2N2917 2N2976		2N2918 2N2977				
SYMBOL	CHARACTERISTICS	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5)	**0.8**	**1.0**	**0.8**	**1.0**		**I_C = 100 μA**	**V_{CE} = 5.0 V**
$\|V_{BE1}\text{-}V_{BE2}\|$	**Base-Emitter Voltage Differential** (Note 6)		**10**		**10**	**mV**	**I_C = 10 μA to 1.0 mA**	**V_{CE} = 5.0 V**
$\|V_{BE1}\text{-}V_{BE2}\|$	**Base-Emitter Voltage Differential** (Note 6)		**5.0**		**5.0**	**mV**	**I_C = 100 μA**	**V_{CE} = 5.0 V**
$\|\Delta(V_{BE1}\text{-}V_{BE2})\|$	**Base-Emitter Voltage Differential Change (T_A = −55°C to +25°C)**		**1.6 (20 μV/°C)**		**1.6 (20μV/°C)**	**mV**	**I_C = 100 μA**	**V_{CE} = 5.0 V**
$\|\Delta(V_{BE1}\text{-}V_{BE2})\|$	**Base-Emitter Voltage Differential Change (T_A = +25°C to +125°C)**		**2.0 (20 μV/°C)**		**2.0 (20μV/°C)**	**mV**	**I_C = 100 μA**	**V_{CE} = 5.0 V**
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**		**4.0**		**3.0**	**dB**	**I_C = 10 μA BW = 200 Hz**	**V_{CE} = 5.0 V R_S = 10 kΩ**
NF	**Wide Band Noise Figure (f = 15.7 kHz)**		**4.0**		**3.0**	**dB**	**I_C = 10 μA 3 dB pts @ 25 Hz & 10 kHz R_S = 10 kΩ**	**V_{CE} = 5.0 V**

PHYSICAL DIMENSIONS



370
335
335
305 DIA
125
009
260
140
Seating Plane
6 LEADS
019
016 DIA
500 MIN
200
100
Emitter
Base
Collector
45°
Emitter
Base
Collector
034
028
045
029

CONNECTION DIAGRAM



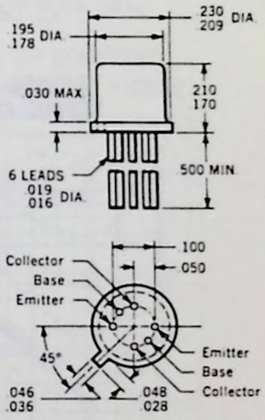
Lead No. 3
Lead No. 2
Lead No. 1
Lead No. 5
Lead No. 6
Lead No. 7

BOTTOM VIEW

NOTES: All dimensions in inches
Leads are gold plated Kovar
Package weight is 1.23 grams

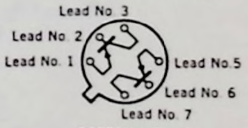
2N2917 • 2N2918

PHYSICAL DIMENSIOI



230
209 DIA
195
178 DIA
030 MAX
210
170
6 LEADS
019
016 DIA
500 MIN
100
050
Collector
Base
Emitter
45°
Emitter
Base
Collector
046
036
048
028

CONNECTION DIAGRAM



Lead No. 3
Lead No. 2
Lead No. 1
Lead No. 5
Lead No. 6
Lead No. 7

BOTTOM VIEW

NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 0.62 gram

2N2976 • 2N2977

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

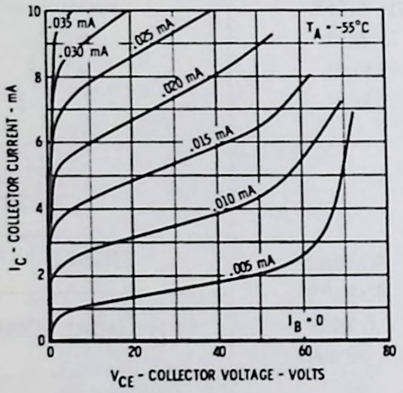
FAIRCHILD TRANSISTORS 2N2917 • 2N2976

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

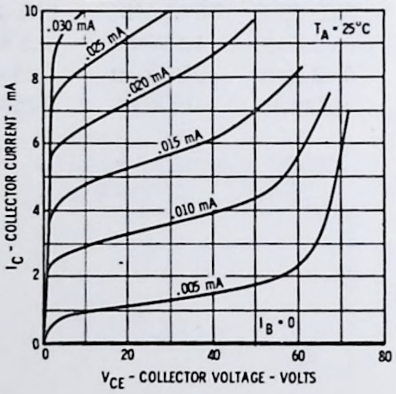
SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	150			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	100			$I_C = 100\ \mu$A	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	60	240		$I_C = 10\ \mu$A	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Current Gain	15			$I_C = 10\ \mu$A	$V_{CE} = 5.0$ V
$V_{CE}(sat)$	Collector Saturation Voltage		0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{BE}(on)$	Emitter-Base On Voltage		0.7	Volts	$I_C = 0.1$ mA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Cutoff Current		10	nA	$I_E = 0$	$V_{CB} = 45$ V
$I_{CBO}(150°C)$	Collector Cutoff Current		10	μA	$I_E = 0$	$V_{CB} = 45$ V
I_{CEO}	Collector Cutoff Current		2.0	nA	$I_B = 0$	$V_{CE} = 5.0$ V
I_{EBO}	Emitter Cutoff Current		2.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{obo}	Output Capacitance		6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0			$I_C = 0.5$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance (f = 1 kHz)	25	32	Ω	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance (f = 1 kHz)		1.0	μmhos	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	45		Volts	$I_C = 10\ \mu$A	$I_E = 0$
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (pulsed, notes 4 and 7)	**45**		**Volts**	**$I_C = 10$ mA**	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		Volts	$I_E = 10\ \mu$A	$I_C = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

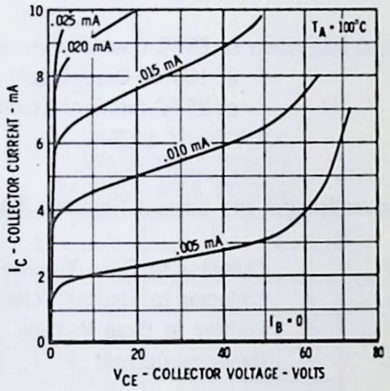
COLLECTOR CHARACTERISTICS



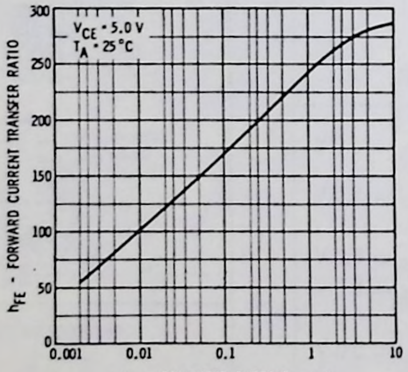
COLLECTOR CHARACTERISTICS



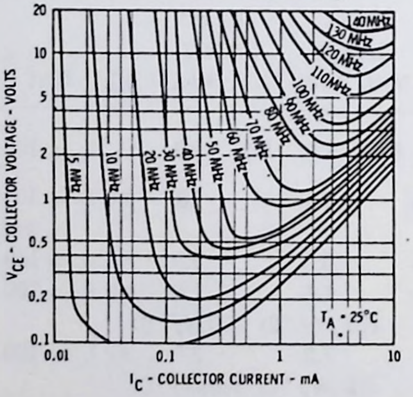
COLLECTOR CHARACTERISTICS



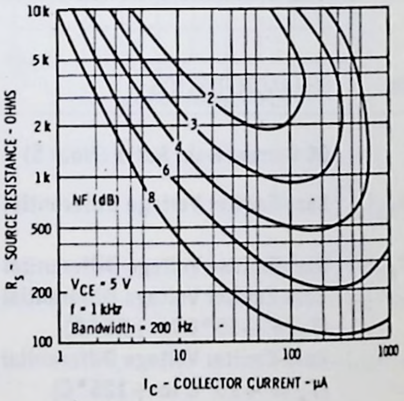
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



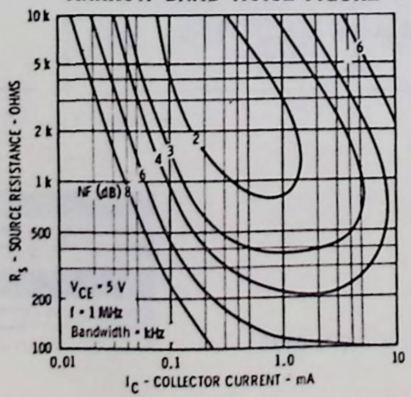
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



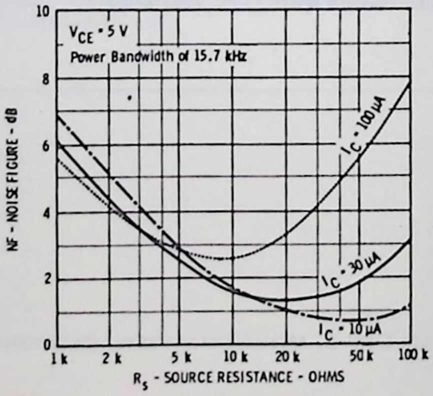
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE

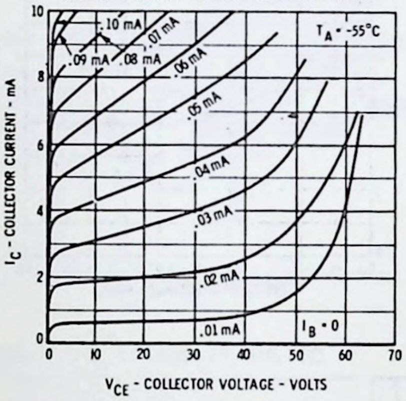


ELLECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

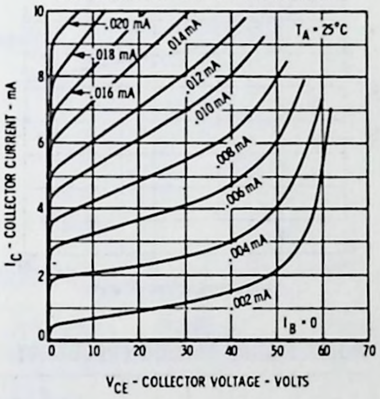
SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	300			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	225			$I_C = 100\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	150	600		$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Current Gain	30			$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
$V_{CE}(sat)$	Collector Saturation Voltage		0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{BE}(on)$	Emitter-Base On Voltage		0.7	Volts	$I_C = 0.1$ mA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Cutoff Current		10	nA	$I_E = 0$	$V_{CB} = 45$ V
$I_{CBO}(150°C)$	Collector Cutoff Current		10	μA	$I_E = 0$	$V_{CB} = 45$ V
I_{CEO}	Collector Cutoff Current		2.0	nA	$I_B = 0$	$V_{CE} = 5.0$ V
I_{EBO}	Emitter Cutoff Current		2.0	nA	$I_C = 0$	$V_{EB} = 5.0$ V
C_{obo}	Output Capacitance		6.0	pF	$I_E = 0$	$V_{CB} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0			$I_C = 0.5$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance (f = 1 kHz)	25	32	Ω	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance (f = 1 kHz)		1.0	μmhos	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	45		Volts	$I_C = 10\ \mu A$	$I_E = 0$
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (pulsed, notes 4 and 7)	45		Volts	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		Volts	$I_E = 10\ \mu A$	$I_C = 0$

TYPICAL ELECTRICAL CHARACTERISTICS

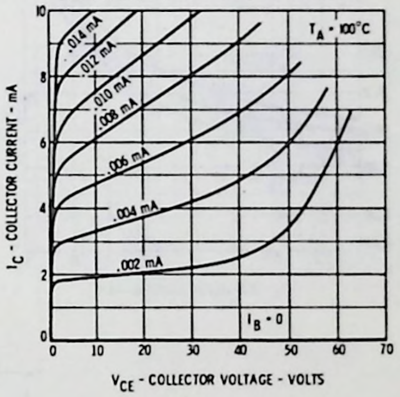
COLLECTOR CHARACTERISTICS



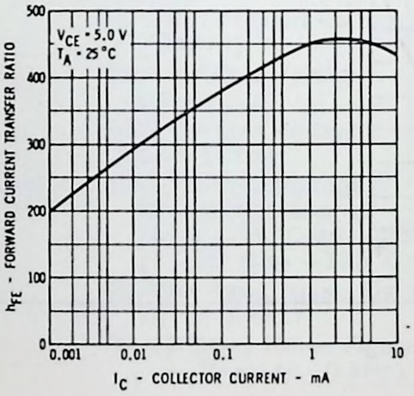
COLLECTOR CHARACTERISTICS



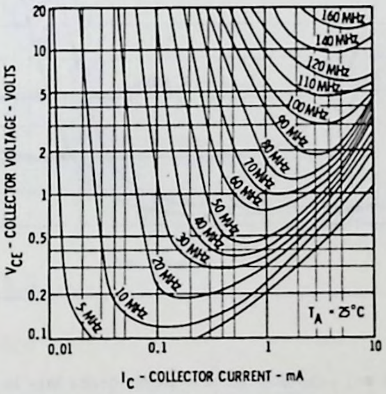
COLLECTOR CHARACTERISTICS



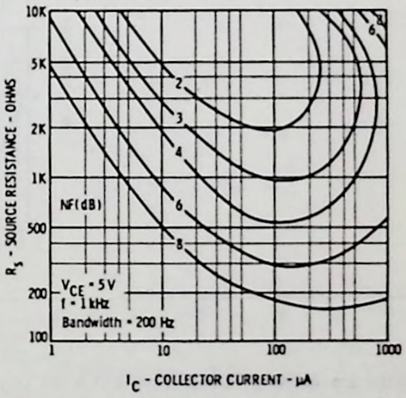
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



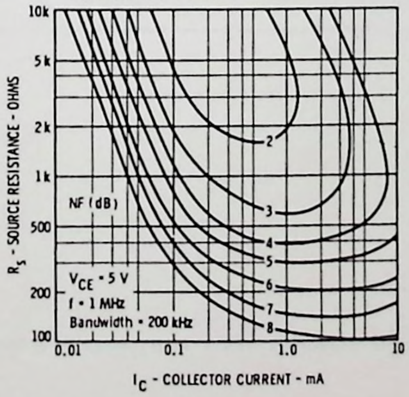
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



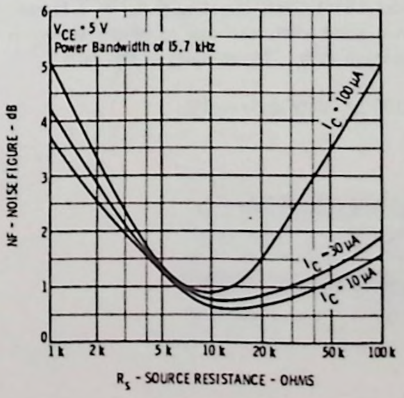
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

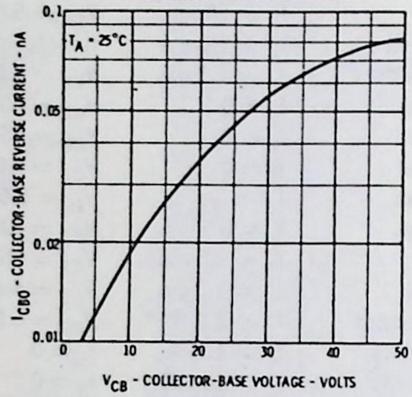


WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE

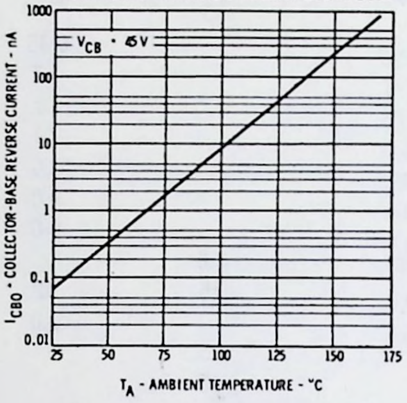


TYPICAL ELECTRICAL CHARACTERISTICS
THESE CURVES APPLY TO ALL UNITS

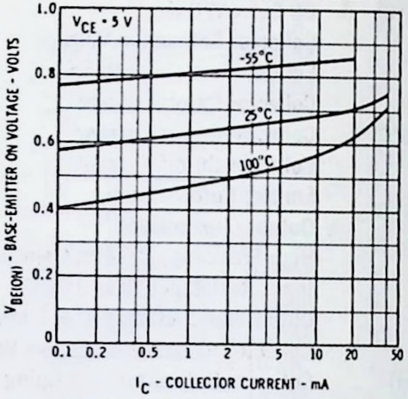
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



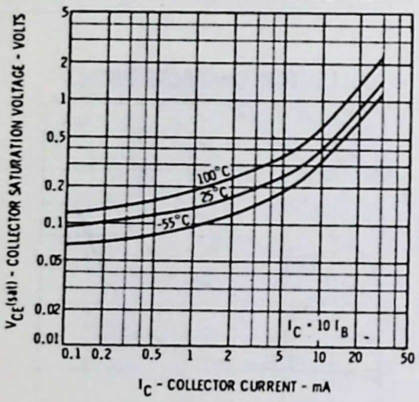
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



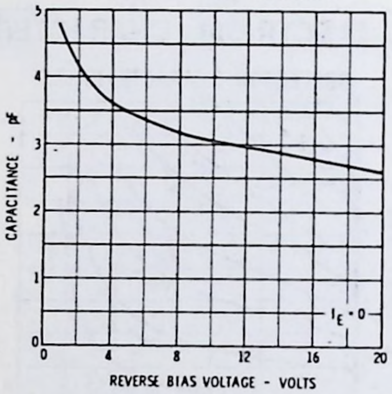
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



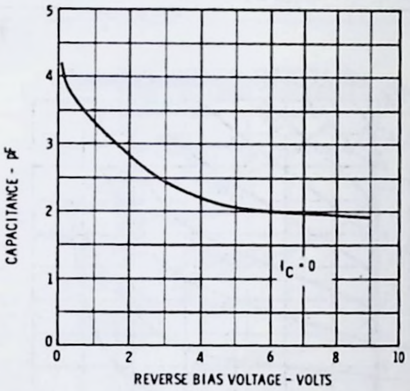
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



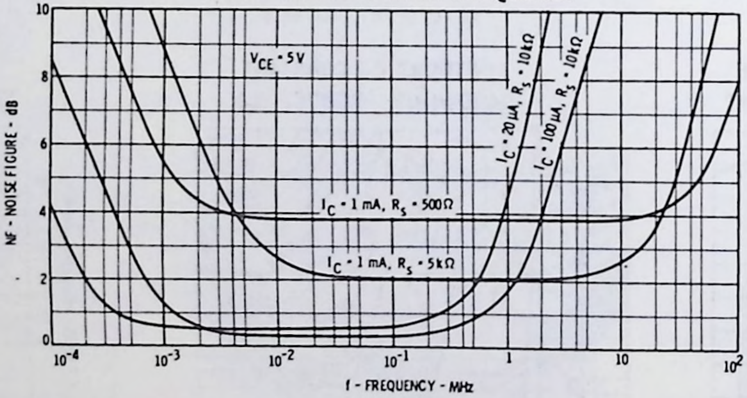
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



NOISE FIGURE VERSUS FREQUENCY



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/Watt (derating factor of 1.71 mW/°C) for one side; 292°C/Watt (derating factor of 3.42 mW/°C) for both sides for the 2N2917 and 2N2918. For the 2N2976 and 2N2977 junction to ambient thermal resistance of 700°C/Watt (derating factor of 1.43 mW/°C) for one side; 584°C/Watt (derating factor of 1.71 mW/°C) for both sides.
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.
(6) Absolute values.
(7) Pulse Conditions: length = 300 μs; duty cycle = 1%.

2N2980 · 2N2981 · 2N2982
NPN DIFFERENTIAL AMPLIFIERS
DIFFUSED SILICON PLANAR* TRANSISTORS

These six-terminal devices each contain two isolated high-gain NPN double-diffused silicon PLANAR transistors in one hermetically sealed enclosure. They are designed for use in high-performance differential amplifier circuits.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	**−65°C to 300°C**
Operating Junction Temperature	**+200°C Maximum**
Lead Temperature (Soldering, No Time Limit)	**+300°C Maximum**

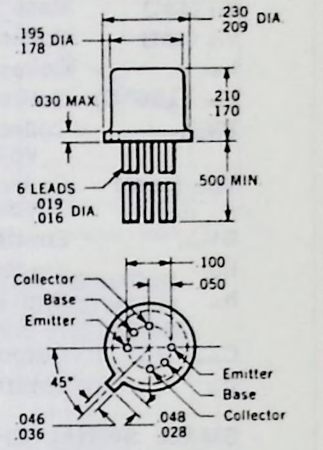
Maximum Power Dissipation

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	**0.5 Watt**	**0.75 Watt**
at 100°C Case Temperature [Notes 2 and 3]	**0.29 Watt**	**0.43 Watt**
at 25°C Ambient Temperature [Notes 2 and 3]	**0.25 Watt**	**0.30 Watt**

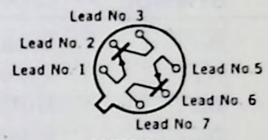
Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	**100 Volts**
V_{CEO}	Collector to Emitter Voltage [Note 4]	**60 Volts**
V_{EBO}	Emitter to Base Voltage	**7.0 Volts**
I_C	Collector Current	**500 mA**

PHYSICAL DIMENSIONS



CONNECTION DIAGRAM



BOTTOM VIEW

NOTES All dimensions in inches
Leads are gold plated kovar
Package weight is 0.62 gram

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N2980 MIN.	2N2980 MAX.	2N2981 MIN.	2N2981 MAX.	2N2982 MIN.	2N2982 MAX.	UNITS	TEST CONDITIONS
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio [Note 5]	0.9	1.0	0.8	1.0	0.9	1.0		$I_C = 100\ \mu A$ $V_{CE} = 5.0\ V$
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio [Note 5]	0.9	1.0						$I_C = 1.0\ mA$ $V_{CE} = 5.0\ V$
$\lvert V_{BE1}-V_{BE2}\rvert$	Base-Emitter Voltage Differential		3.0		15		5.0	mV	$I_C = 100\ \mu A$ $V_{CE} = 5.0\ V$
$\lvert V_{BE1}-V_{BE2}\rvert$	Base-Emitter Voltage Differential		5.0					mV	$I_C = 1.0\ mA$ $V_{CE} = 5.0\ V$
$\Delta(V_{BE1}-V_{BE2})$	Base-Emitter Voltage Differential Change ($T_A = -55°C$ to $+25°C$ or $+25°C$ to $+125°C$)		10		25		15	μV/°C	$I_C = 100\ \mu A$ $V_{CE} = 5.0\ V$
NF	Narrow Band Noise Figure (f = 1.0 kHz)	8.0						dB	$I_C = 0.3\ mA$ $V_{CE} = 10\ V$ B.W. = 200 Hz $R_g = 510\ \Omega$
NF	Broad Band Noise Figure (f = 25 Hz to 10 kHz)	8.0						dB	$I_C = 0.3\ mA$ $V_{CE} = 10\ V$ B.W. = 15.7 kHz $R_g = 1.0\ k\Omega$

* Planar is a patented Fairchild process

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

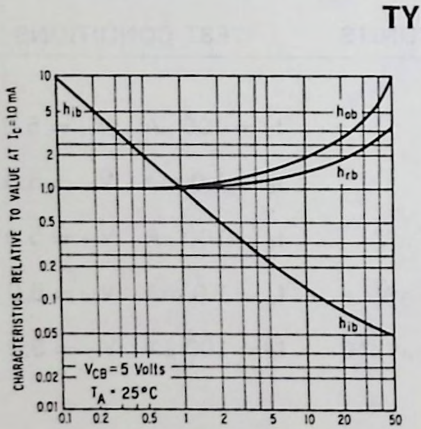
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise specified)

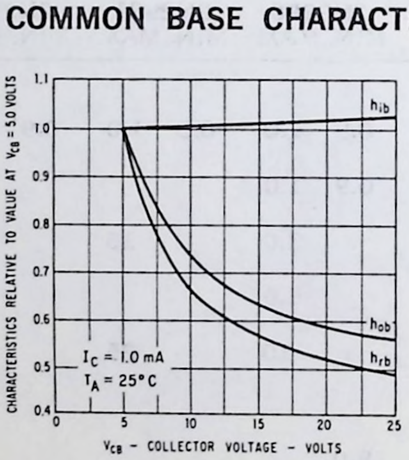
SYMBOL	CHARACTERISTIC	2N2980 MIN.	2N2980 TYP.	2N2980 MAX.	2N2981 2N2982 MIN.	2N2981 2N2982 TYP.	2N2981 2N2982 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 6]	50	100	150	50	125	200		$I_C = 10$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	40	80	120					$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	30	60	90	25	60	150		$I_C = 100\mu A$	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	25	50	75	15	50			$I_C = 10\mu A$	$V_{CE} = 5.0$ V
V_{BE} (sat)	Base Saturation Voltage		0.7	0.9		0.7	0.9	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		0.35	1.2		0.35	1.2	Volts	$I_C = 50$ mA	$I_B = 5.0$ mA
I_{CBO}	Collector Cutoff Current		0.4	2.0		0.4	10	nA	$I_E = 0$	$V_{CB} = 80$ V
I_{CBO} (150°C)	Collector Cutoff Current		1.3	10		1.3	15	μA	$I_E = 0$	$V_{CB} = 80$ V
BV_{CBO}	Collector to Base Breakdown Voltage	100			100			Volts	$I_C = 100\mu A$	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 6]	60			60			Volts	$I_C = 30$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter Breakdown Voltage	7.0			7.0			Volts	$I_C = 0$	$I_E = 100\ \mu A$
I_{EBO}	Emitter Cutoff Current		0.1	2.0		0.1	10	nA	$I_C = 0$	$V_{EB} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0	5.0		2.5	5.0			$I_C = 50$mA	$V_{CE} = 10$ V
C_{obo}	Output Capacitance	8.0	12	15	8.0	12	15	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{TE}	Emitter Transition Capacitance	30	60	85	30	60	85	pF	$I_C = 0$	$V_{EB} = 0.5$ V

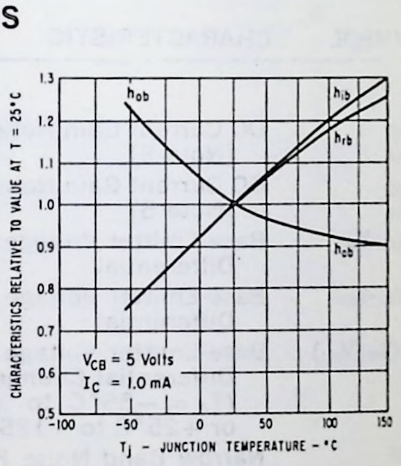
SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

SYMBOL	CHARACTERISTIC	2N2980 MIN.	2N2980 TYP.	2N2980 MAX.	2N2981 2N2982 MIN.	2N2981 2N2982 TYP.	2N2981 2N2982 MAX.	UNITS	TEST CONDITIONS	
h_{fe}	Small Signal Current Gain	50	80	150	40	125	200		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ie}	Input Resistance	1.25	2.3	5.0	1.0		6.0	kohms	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance	5.0	9.0	20			30	μmhos	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance	20	27	30	20	27	30	Ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance	0.1		0.5	0.1	0.2	0.5	μmhos	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
h_{rb}	Voltage Feedback Ratio			3.0		0.9	3.0	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V

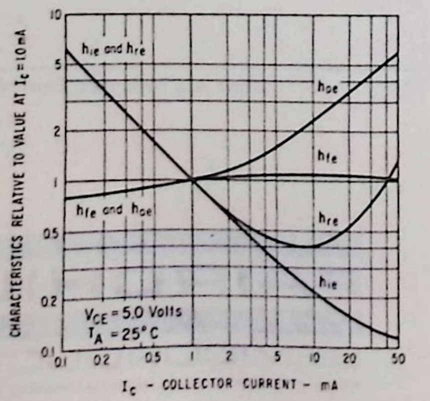
TYPICAL COMMON BASE CHARACTERISTICS

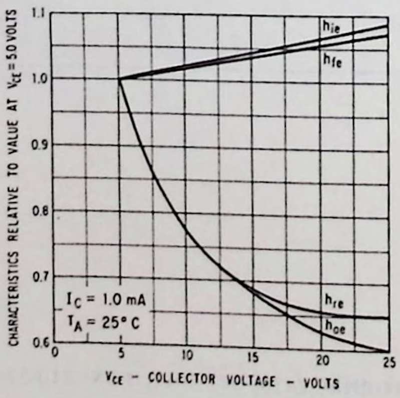


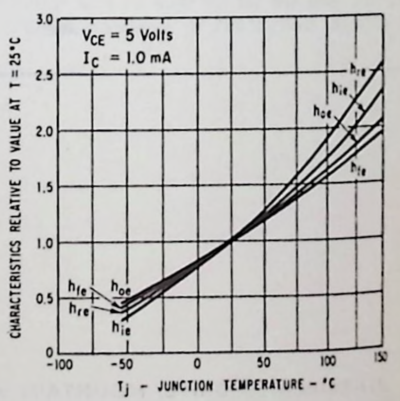




TYPICAL COMMON EMITTER CHARACTERISTICS

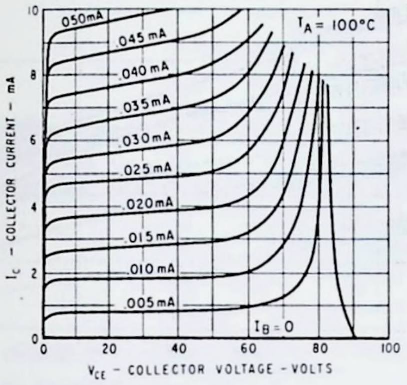


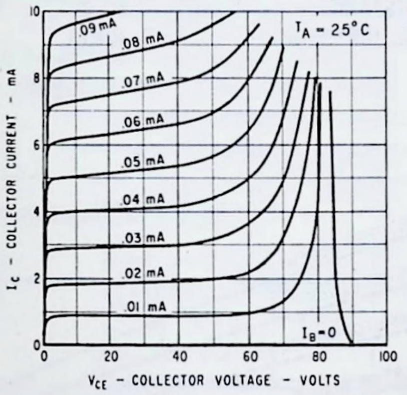


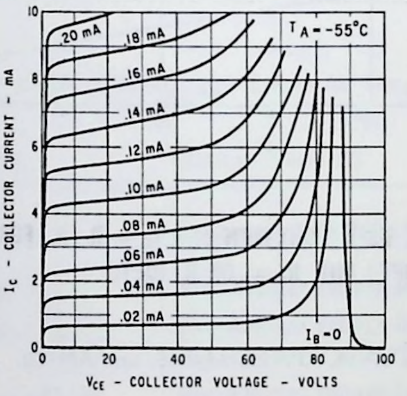


TYPICAL ELECTRICAL CHARACTERISTICS

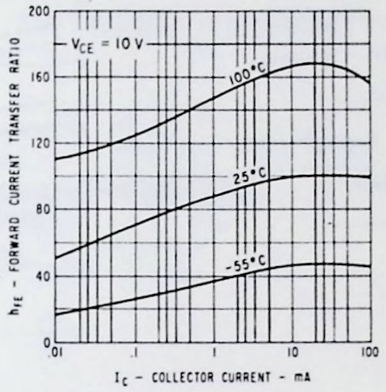
HIGH VOLTAGE COLLECTOR CHARACTERISTICS*



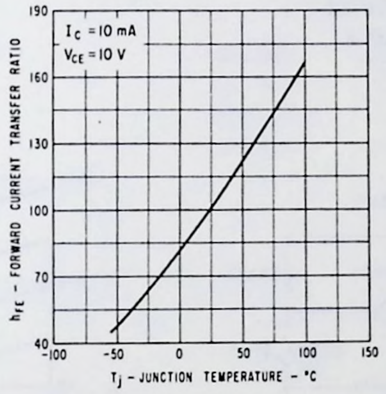




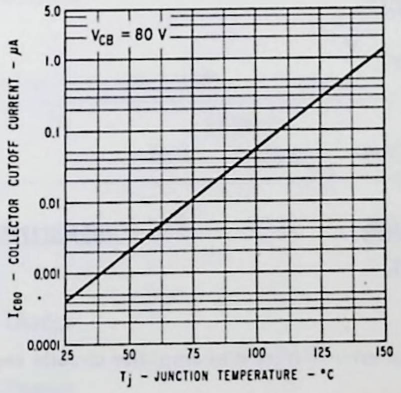
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



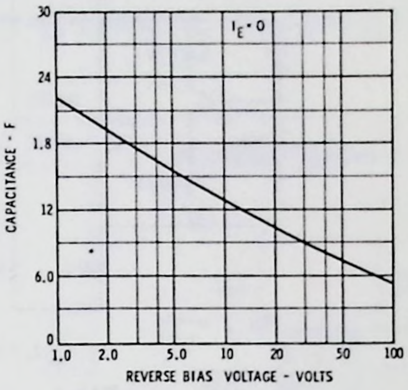
DC PULSE CURRENT GAIN VERSUS TEMPERATURE



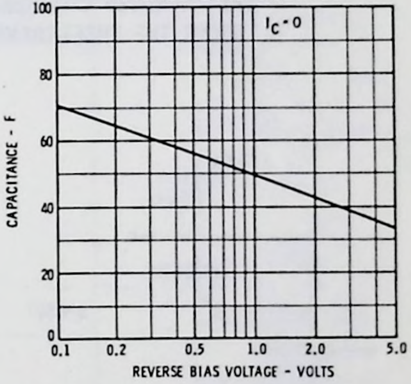
COLLECTOR CUTOFF CURRENT VERSUS TEMPERATURE



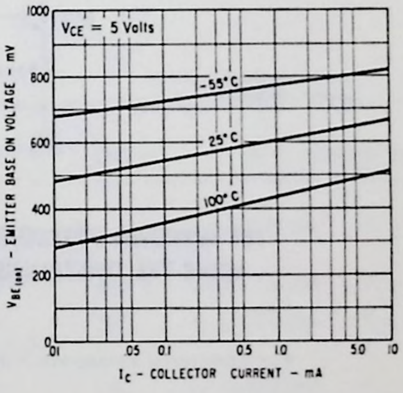
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

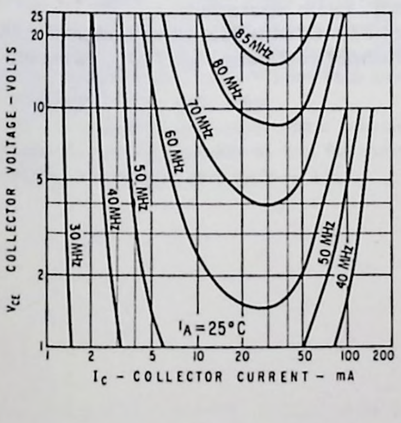


EMITTER-BASE ON VOLTAGE VERSUS COLLECTOR CURRENT

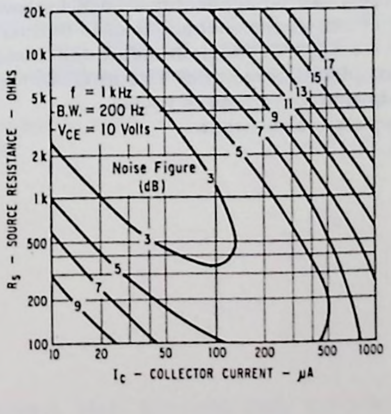


*Single family characteristics on Transistor Curve Tracer.

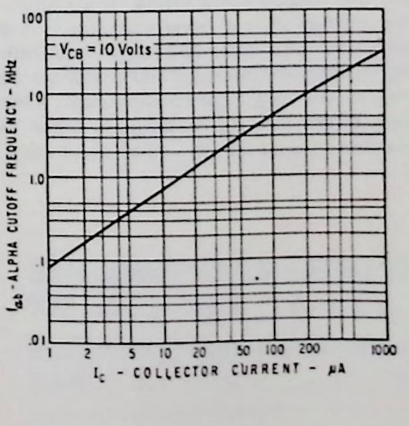
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

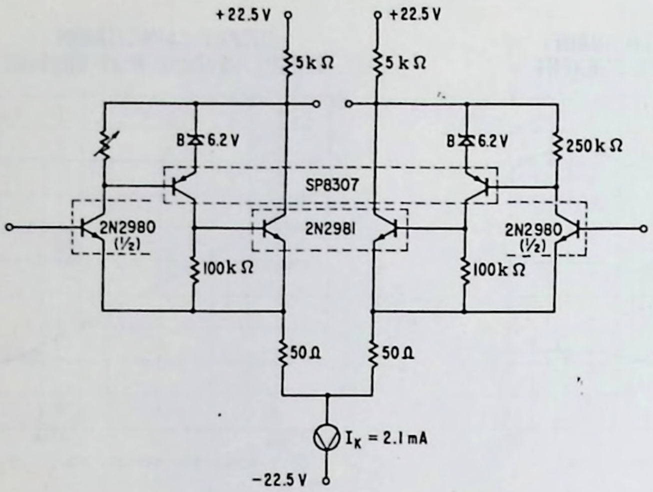


CONTOURS OF NARROW BAND NOISE FIGURE

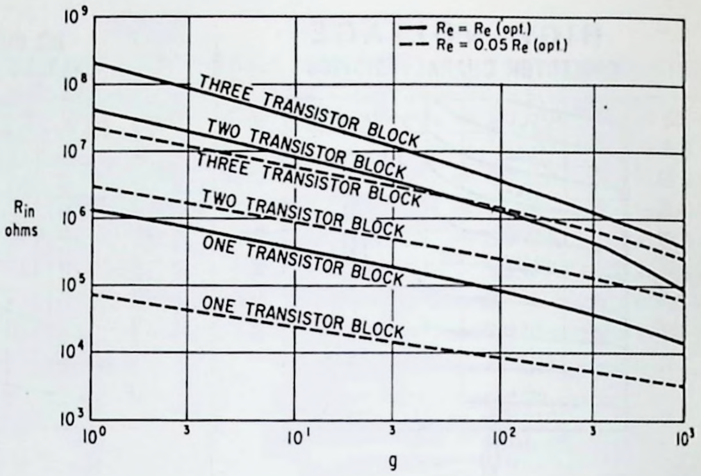


ALPHA CUTOFF FREQUENCY VERSUS COLLECTOR CURRENT

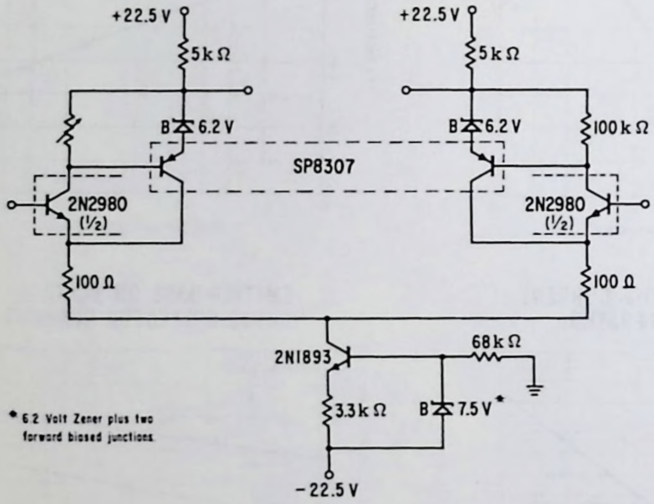



+22.5 V
+22.5 V
5 kΩ
5 kΩ
B 6.2 V
B 6.2 V
250 kΩ
SP8307
2N2980 (½)
2N2981
2N2980 (½)
100 kΩ
100 kΩ
50 Ω
50 Ω
I_K = 2.1 mA
-22.5 V

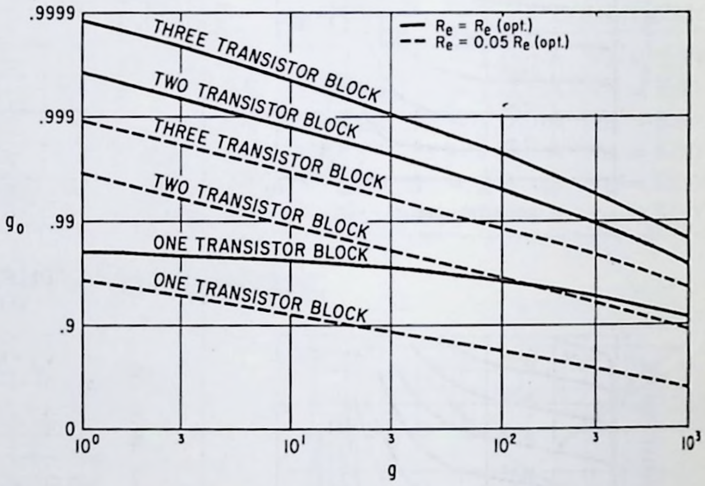
THE IMPROVED DIFFERENTIAL AMPLIFIER USING THE THREE-TRANSISTOR BLOCK.



INPUT RESISTANCE AS A FUNCTION OF g FOR $R_e = R_e$ (OPT.) AND $R_e = .05\ R_e$ (OPT.)


+22.5 V
+22.5 V
5 kΩ
5 kΩ
B 6.2 V
B 6.2 V
100 kΩ
SP8307
2N2980 (½)
2N2980 (½)
100 Ω
100 Ω
2N1893
68 kΩ
3.3 kΩ
B 7.5 V*
-22.5 V
* 6.2 Volt Zener plus two forward biased junctions

THE IMPROVED DIFFERENTIAL AMPLIFIER USING THE TWO-TRANSISTOR BLOCK.



NORMALIZED GAIN, g_o, AS A FUNCTION of g ($g = R_L/R_e$) FOR $R_e = R_e$(OPT.) AND $R_e = .05\ R_e$ (OPT.)

For additional information on these and other differential amplifier circuits see Fairchild TP-16, APP-23, APP-45, and APP-60.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 350°C/watt (derating factor of 2.86 mW/°C) for one side; 233°C/watt (derating factor of 4.3 mW/°C) for both sides. Junction-to-ambient thermal resistance of 700°C/watt (derating factor of 1.43 mW/°C) for one side; 583°C/watt (derating factor of 1.72 mW/°C) for both sides.
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Lowest of the two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.
(6) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

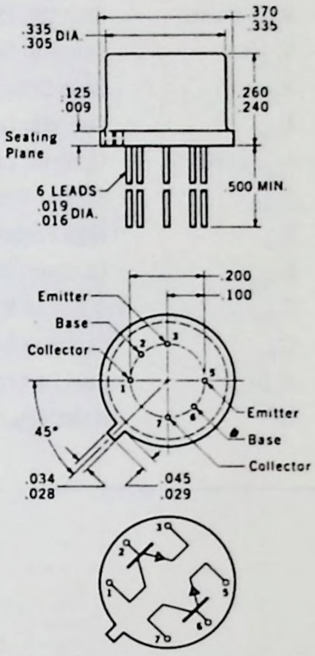
2N3423 • 2N3424

NPN LOW-NOISE, SENSE AND HIGH FREQUENCY DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **BETA MATCH . . . . 10% AT 3.0 mA**
- **V_{BE} DIFFERENTIAL . . . . 5.0 mV (MAX) AT 3.0 mA**
- **V_{BE} DIFFERENTIAL TRACKING . . . 20 μV/°C (MAX) AT 3.0 mA, −55°C TO +125°C**
- **f_T . . . . 600 MHz (MIN) AT 4.0 mA**
- **NF . . . . 3.5 dB (TYP) AT 60 MHz**

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 1.27 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)	**One Side**	**Both Sides**
Total Dissipation at 25°C Case Temperature	0.6 Watt	1.2 Watt
at 100°C Case Temperature	0.25 Watt	0.5 Watt
at 25°C Ambient Temperature	0.3 Watt	0.45 Watt

Maximum Voltages and Current		**2N3423 2N3424**
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA
$V_{C1\,C2}$	Collector$_1$ to Collector$_2$ Voltage	±200 Volts
	Voltage rating any lead to case	±200 Volts

MATCHING CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N3423		2N3424				
SYMBOL	CHARACTERISTICS	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5)	0.8	1.0	0.9	1.0		$I_C = 3.0$ mA	$V_{CE} = 3.0$ V
$\lvert V_{BE1} - V_{BE2} \rvert$	**Base-Emitter Voltage Differential**		10		5.0	mV	$I_C = 3.0$ mA	$V_{CE} = 3.0$ V
$\lvert \Delta(V_{BE1} - V_{BE2}) \rvert$	**Base-Emitter Voltage Differential Change ($T_A = -55°C$ to 25°C)**		3.2 (40 μV/°C)		1.6 (20 μV/°C)	mV	$I_C = 3.0$ mA	$V_{CE} = 3.0$ V
$\lvert \Delta(V_{BE1} - V_{BE2}) \rvert$	**Base-Emitter Voltage Differential Change ($T_A = 25°C$ to 125°C)**		4.0 (40 μV/°C)		2.0 (20 μV/°C)	mV	$I_C = 3.0$ mA	$V_{CE} = 3.0$ V

* Planar is a patented Fairchild process.

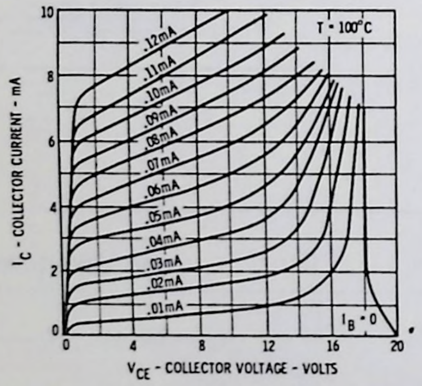
NOTES:

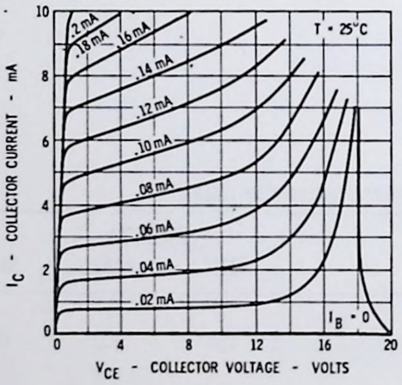
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/Watt (derating factor of 1.72 mW/°C) for one side; 389°C/Watt (derating factor of 2.57 mW/°C) for both sides. Junction to case thermal resistance of 290°C/Watt (derating factor of 3.44 mW/°C) for one side; 145°C/Watt (derating factor of 6.85 mW/°C) for both sides.
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.
(6) Pulse Conditions = 300 μs; duty cycle = 1%.

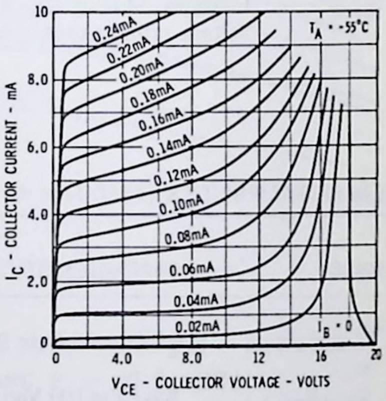
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20			$I_C = 3.0$ mA	$V_{CE} = 1.0$ V
h_{FE}	DC Current Gain	20	200		$I_C = 3.0$ mA	$V_{CE} = 3.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	30			$I_C = 1.0\,\mu$A	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			$I_C = 0$	$I_E = 10\,\mu$A
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 6)	15			$I_C = 3.0$ mA	$I_B = 0$
V_{CE}(sat)	Collector Saturation Voltage		0.4	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage		1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
I_{CBO}	Collector Cutoff Current		10	nA	$I_E = 0$	$V_{CB} = 15$ V
I_{CBO}(150°C)	Collector Cutoff Current		1.0	μA	$I_E = 0$	$V_{CB} = 15$ V
I_{CBO}	Emitter Cutoff Current		10	μA	$I_C = 0$	$V_{EB} = 3.0$ V
h_{fe}	**High Frequency Current Gain**	**6.0**	**12**		**$I_C = 4.0$ mA, $V_{CE} = 10$ V, f = 100 MHz**	
C_{obo}	Common-Base Output Capacitance		1.7	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{obo}	Common-Base Output Capacitance		3.0	pF	$I_E = 0$	$V_{CB} = 0$
C_{ibo}	Common-Base Input Capacitance		2.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
$R_e(h_{ie})$	Real Part of Common-Emitter Input Impedance		45	Ω	$I_C = 3.0$ mA $V_{CE} = 3.0$ V f = 350 MHz	
NF	**Noise Figure**	**3.5 (Typ.)**		**dB**	**$I_C = 1.0$ mA** **f = 60 MHz,**	**$V_{CE} = 6.0$ V** **$R_g = 400\Omega$**

TYPICAL COLLECTOR CHARACTERISTICS*

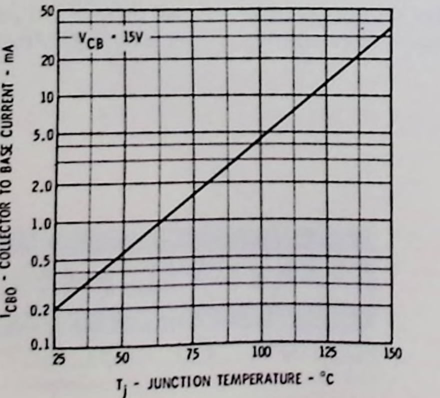




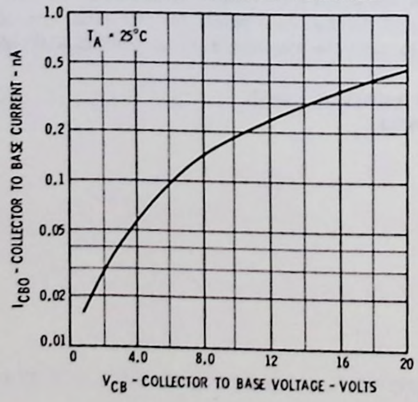


TYPICAL ELECTRICAL CHARACTERISTICS

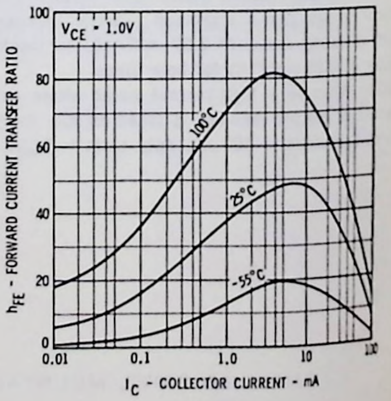
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS VOLTAGE



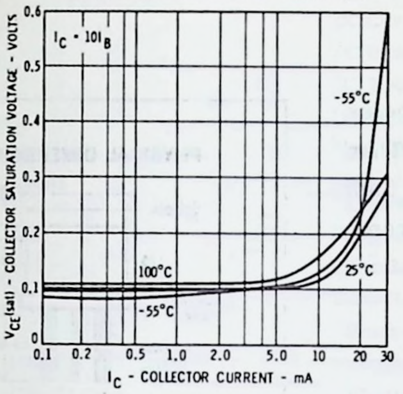
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



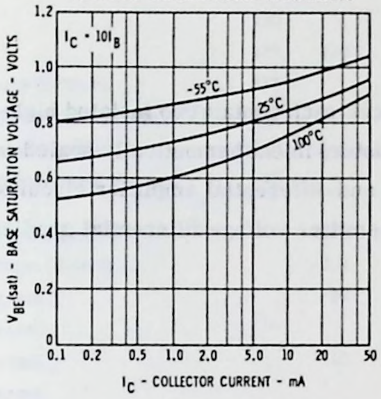
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

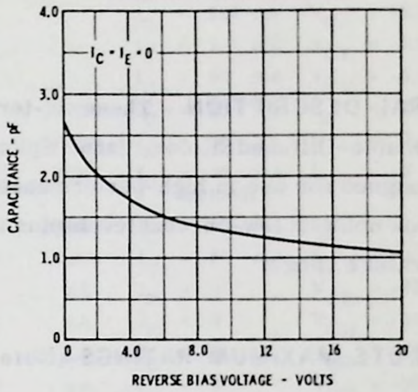
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



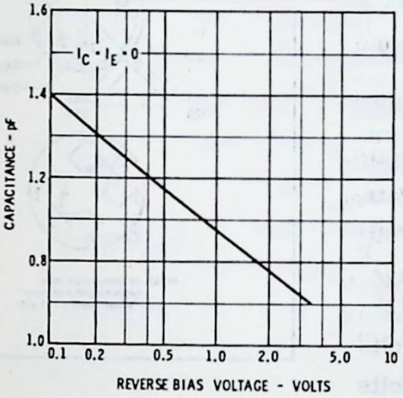
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



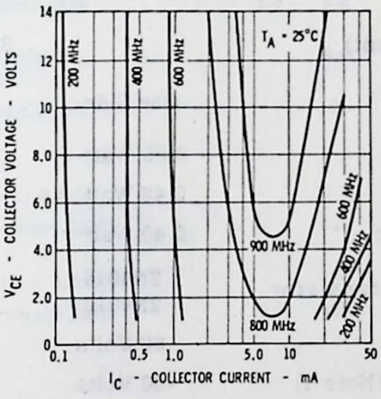
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



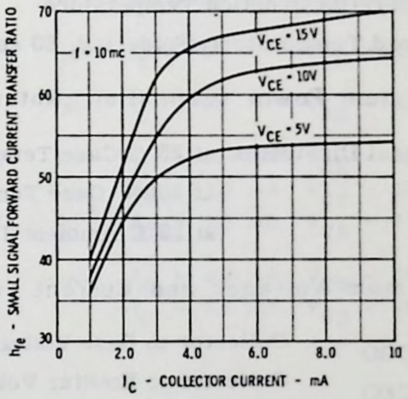
INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



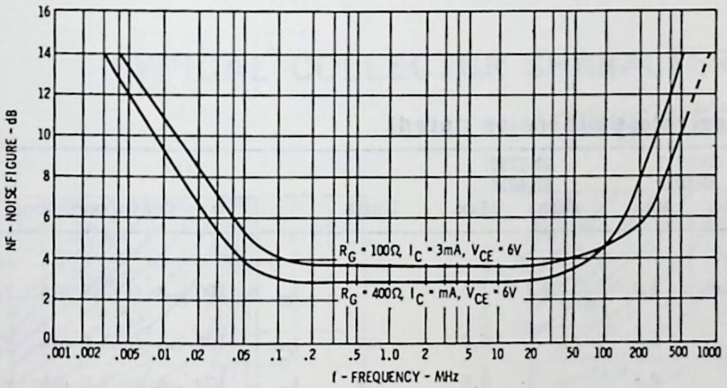
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



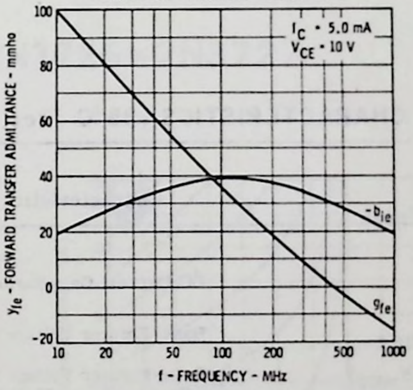
SMALL SIGNAL CURRENT GAIN VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



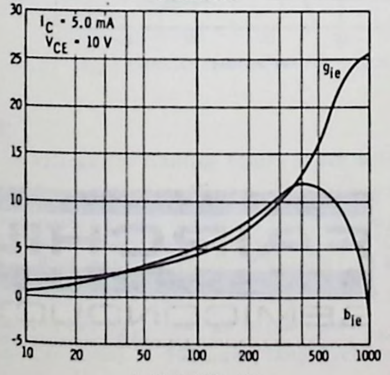
NOISE FIGURE VERSUS FREQUENCY



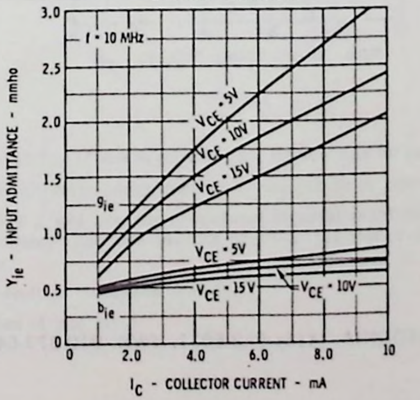
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



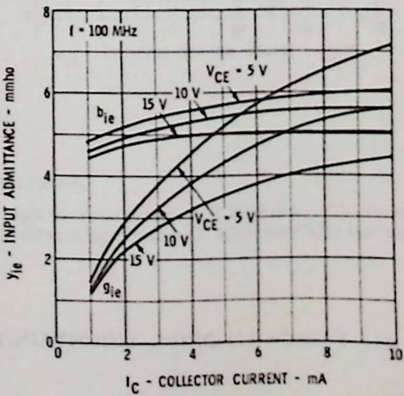
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT



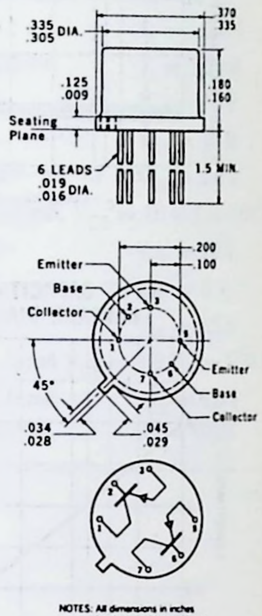
2N3726 · 2N3727 · 2N4015 · 2N4016

PNP LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - These six-terminal devices each contain two isolated high-gain, low-noise PNP Double-Diffused Silicon Planar Epitaxial Transistors in one hermetically sealed enclosure. They are designed for use in high-performance amplifier and differential amplifier circuits requiring high gain, low noise at low-current levels plus a low base-emitter voltage differential gradient over extreme temperature range.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 1.08 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	0.85 Watt	1.4 Watts
at 100°C Case Temperature	0.48 Watt	0.80 Watt
at 25°C Ambient Temperature	0.40 Watt	0.50 Watt

Maximum Voltages and Current For Each Transistor

			2N4015 2N4016	2N3726 2N3727
V_{CBO}	Collector to Base Voltage		-60 Volts	-45 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-60 Volts	-45 Volts
V_{EBO}	Emitter to Base Voltage		-5.0 Volts	-5.0 Volts
I_C	Collector Current		300 mA	300 mA

MATCHING CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N3727 2N4016 Min.	Max.	2N3726 2N4015 Min.	Max.	Units	Test Conditions
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio (Note 5)	0.9	1.0	0.9	1.0		I_C = 100 µA to 1.0 mA V_{CE} = -5.0 V
$V_{BE1} - V_{BE2}$	Base-Emitter Voltage Differential		2.5		5.0	mV	I_C = 100 µA to 1.0 mA V_{CE} = -5.0 V
$\Delta(V_{BE1} - V_{BE2})$	Base-Emitter Voltage Differential Change (T_A = -55°C to 25°C)		0.8		1.6	mV	I_C = 100 µA to 1.0 mA V_{CE} = -5.0 V
$\Delta(V_{BE1} - V_{BE2})$	Base-Emitter Voltage Differential Change (T_A = 25°C to 125°C)		1.0		2.0	mV	I_C = 100 µA to 1.0 mA V_{CE} = -5.0 V

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

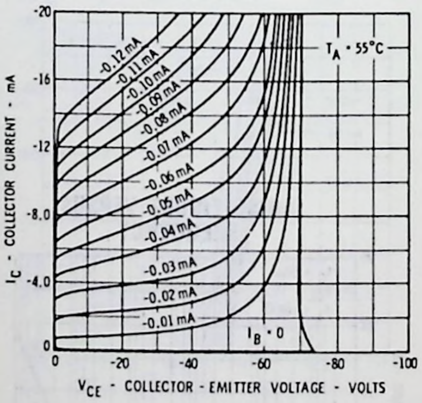
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

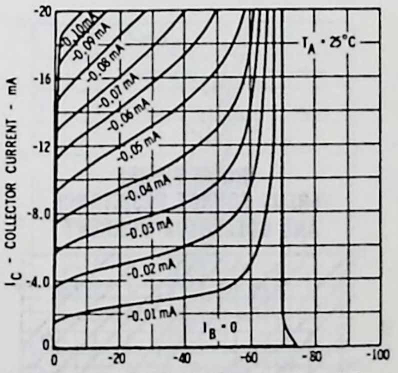
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

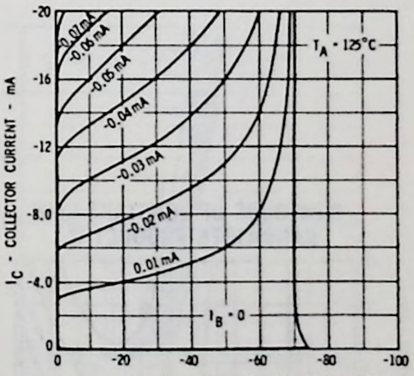
Symbol	Characteristic	2N3726 2N3727 Min.	Max.	2N4015 2N4016 Min.	Max.	Units	Test Conditions
h_{FE}	DC Current Gain	80		80			I_C = 10 μA V_{CE} = -5.0 V
h_{FE}	DC Current Gain	120		120			I_C = 100 μA V_{CE} = -5.0 V
h_{FE}	DC Current Gain	135	350	135	350		I_C = 1.0 mA V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 6)	115		115			I_C = 50 mA V_{CE} = -5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	-45		-60		Volts	I_C = 10 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		Volts	I_E = 10 μA I_C = 0
$V_{CEO}(sust)$	Collector to Emitter Sustaining Voltage (Notes 4 and 6)	-45		-60		Volts	I_C = 10 mA (pulsed) I_B = 0
$V_{CE}(sat)$	Collector Saturation Voltage (Note 6)		-0.25		-0.25	Volts	I_C = 50 mA I_B = 2.5 mA
$V_{BE}(sat)$	Base Saturation Voltage (Note 6)		-1.0		-1.0	Volts	I_C = 50 mA I_B = 2.5 mA
I_{CBO}	Collector Cutoff Current		10			nA	I_E = 0 V_{CB} = -30 V
I_{CBO}	Collector Cutoff Current				10	nA	I_E = 0 V_{CB} = -50 V
$I_{CBO}(150°C)$	Collector Cutoff Current		10			μA	I_E = 0 V_{CB} = -30 V
$I_{CBO}(150°C)$	Collector Cutoff Current				10	μA	I_E = 0 V_{CB} = -50 V
I_{EBO}	Emitter Cutoff Current		100		100	nA	I_C = 0 V_{EB} = -3.0 V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	3.0		3.0			I_C = 1.0 mA V_{CE} = -10 V
h_{fe}	High Frequency Current Gain (f = 100 Mc)	2.0	6.0	2.0	6.0		I_C = 50 mA V_{CE} = -20 V
C_{obo}	Common-Base, Open-Circuit, Output Capacitance		8.0		8.0	pf	I_E = 0 V_{CB} = -10 V
C_{ibo}	Common-Base, Open-Circuit, Input Capacitance		25		25	pf	I_C = 0 V_{EB} = -0.5 V
NF	Noise Figure (Note 7)		4.0		4.0	db	I_C = 30 μA V_{CE} = -5.0 V
h_{ie}	Input Impedance (f = 1.0 Kc)		11.5		11.5	KOhm	I_C = 1.0 mA V_{CE} = -10 V
h_{re}	Reverse Voltage Feedback Ratio (f = 1.0 Kc)		1500		1500	$x10^{-6}$	I_C = 1.0 mA V_{CE} = -10 V
h_{oe}	Output Conductance (f = 1.0 Kc)		80		80	μmho	I_C = 1.0 mA V_{CE} = -10 V
h_{fe}	Forward Current Transfer Ratio (f = 1.0 Kc)	135	420	135	420		I_C = 1.0 mA V_{CE} = -10 V

TYPICAL COLLECTOR CHARACTERISTICS* 2N3726 • 2N3727

ACTIVE REGION







NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 431°C/Watt (derating factor of 2.29 mW/°C) for one side; 350°C/Watt (derating factor of 2.86 mW/°C) for both sides. Junction-to-case thermal resistance of 206°C/Watt (derating factor of 4.85 mW/°C) for one side; 125°C/Watt (derating factor of 8.0 mW/°C) for both sides.

(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.

(6) Pulse Conditions = 300 μsec; Duty Cycle = 1%.

(7) f = 1.0 Kc; R_s = 10 KΩ. BW = 200 cps.

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* Single family characteristic on Transistor Curve Tracer.

2N3728 • 2N3729

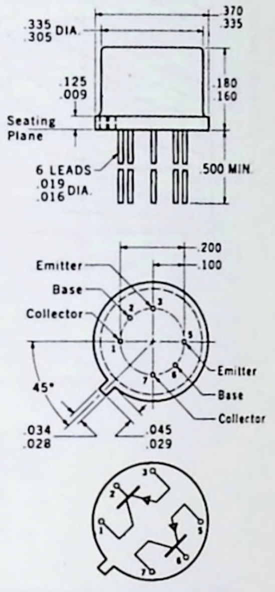
NPN HIGH PERFORMANCE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **BETA RATIO - -** $\dfrac{h_{FE1}}{h_{FE2}}$ **= 0.9-1.0 FROM 100 μA to 1.0 mA**

  $\dfrac{h_{FE1}}{h_{FE2}}$ **= 0.8-1.0 FROM 100 μA to 1.0 mA, −55°C to +125°C**
- **V_{BE} MATCHING - -** $|V_{BE1} - V_{BE2}|$ **= 3.0 mV (MAX) FROM 100 μA to 1.0 mA**
- **V_{BE} TRACKING - -** ΔV_{BE} **= 10 μV/°C (MAX) FROM 100 μA to 1.0 mA, −55°C to +125°C**
- **MEDIUM VOLTAGE - -** LV_{CEO} **= 30 V (MIN)**

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 1.08 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum

Maximum Power Dissipation

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.0 Watt	1.6 Watt
at 100°C Case Temperature (Notes 2 and 3)	0.57 Watt	0.91 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	0.45 Watt	0.55 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	500 mA
$V_{C1\,C2}$	Collector$_1$ to Collector$_2$ Voltage	±200 Volts
	Voltage rating any lead to case	±200 Volts

MATCHING CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N3728 MIN.	2N3728 MAX.	2N3729 MIN.	2N3729 MAX.	UNITS	TEST CONDITIONS	
$\dfrac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5)	0.8	1.0	**0.9**	**1.0**		**I_C = 100 μA to 1.0 mA**	V_{CE} = 5.0 V
$\dfrac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5) **(T_A = −55°C to 125°C)**			**0.8**	**1.0**		**I_C = 100 μA to 1.0 mA**	V_{CE} = 5.0 V
$\|V_{BE1} - V_{BE2}\|$	**Base-Emitter Voltage Differential**		5.0		**3.0**	**mV**	**I_C = 100 μA to 1.0 mA**	V_{CE} = 5.0 V
$\|\Delta(V_{BE1} - V_{BE2})\|$	**Base-Emitter Voltage Differential Change (T_A = −55°C to 25°C)**		1.6 (20 μV/°C)		**0.8** **(10 μV/°C)**	**mV**	**I_C = 100 μA to 1.0 mA**	V_{CE} = 5.0 V
$\|\Delta(V_{BE1} - V_{BE2})\|$	**Base-Emitter Voltage Differential Change (T_A = 25°C to 125°C)**		2.0 (20 μV/°C)		**1.0** **(10 μV/°C)**	**mV**	**I_C = 100 μA to 1.0 mA**	V_{CE} = 5.0 V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 384°C/Watt (derating factor of 2.57 mW/°C) for one side; 318°C/Watt (derating factor of 3.14 mW/°C) for both sides. Junction to case thermal resistance of 175°C/Watt (derating factor of 5.71 mW/°C) for one side; 109°C/Watt (derating factor of 9.15 mW/°C) for both sides.
(4) Rating refers to a high-current point where collector to emitter voltage is lowest.
(5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.
(6) Pulse Conditions: length = 300 μs; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

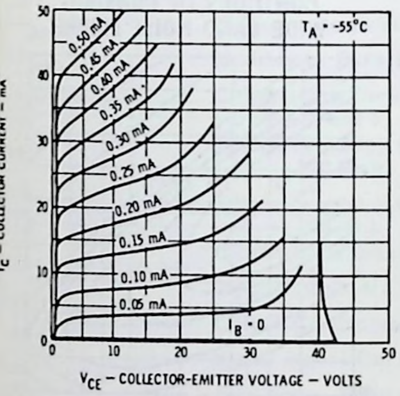
FAIRCHILD TRANSISTORS 2N3728 • 2N3729

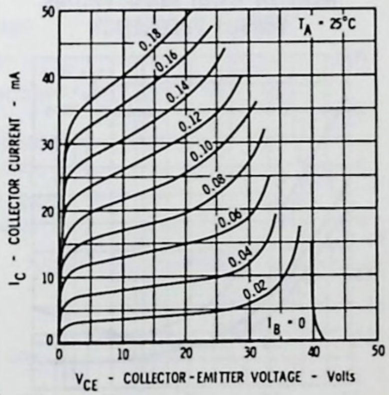
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

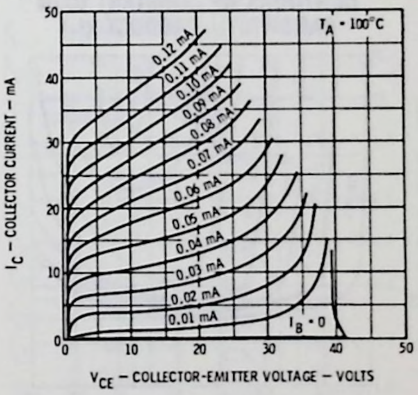
SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	30			$I_C = 0.1$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	45	180		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain (Note 6)	80	280		$I_C = 150$ mA	$V_{CE} = 5.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	60			$I_C = 10\ \mu A$	$I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			$I_C = 0$	$I_E = 10\ \mu A$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 6)	30			$I_C = 10$ mA	$I_B = 0$
V_{CE}(sat)	Collector Saturation Voltage (Note 6)		0.22	Volts	$I_C = 150$ mA	$I_B = 15$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 6)		1.1	Volts	$I_C = 150$ mA	$I_B = 15$ mA
I_{CBO}	Collector Cutoff Current		10	nA	$I_E = 0$	$V_{CB} = 50$ V
I_{CBO}(150°C)	Collector Cutoff Current		10	μA	$I_E = 0$	$V_{CB} = 50$ V
I_{EBO}	Emitter Cutoff Current		10	nA	$I_C = 0$	$V_{EB} = 3.0$ V
h_{fe}	High Frequency Current Gain	4.0			$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 20 MHz	
h_{fe}	High Frequency Current Gain	2.5	6.0		$I_C = 50$ mA, $V_{CE} = 10$ V, f = 100 MHz	
C_{obo}	Common-Base, Open-Circuit Output Capacitance		8.0	pF	$I_E = 0$, $V_{CB} = 10$ V, f = 140 kHz	
C_{ibo}	Common-Base, Open-Circuit Input Capacitance		20	pF	$I_C = 0$, $V_{EB} = 2.0$ V, f = 140 kHz	
h_{ie}	Input Impedance	1.2	4.0	kΩ	$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	
h_{re}	Reverse Voltage Feedback Ratio		200	x10^{-6}	$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	
h_{oe}	Output Conductance		10		$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	
h_{fe}	Forward Current Transfer Ratio	50	200		$I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz	
NF	Wideband Noise Figure (f = 15.7 kHz)		7.0	dB	$I_C = 0.1$ mA	$V_{CE} = 5.0$ V
					3 dB pts @ 25 Hz and 10 kHz $R_S = 1.0$ kΩ	

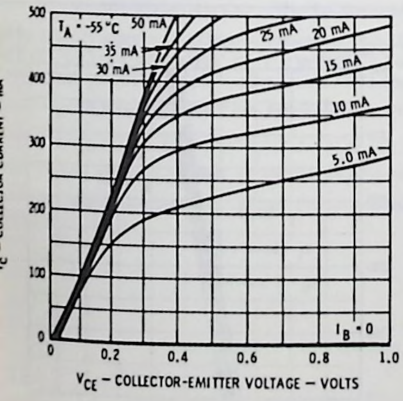
TYPICAL COLLECTOR CHARACTERISTICS*

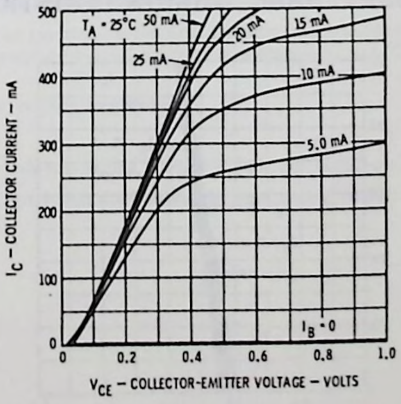
Active Region

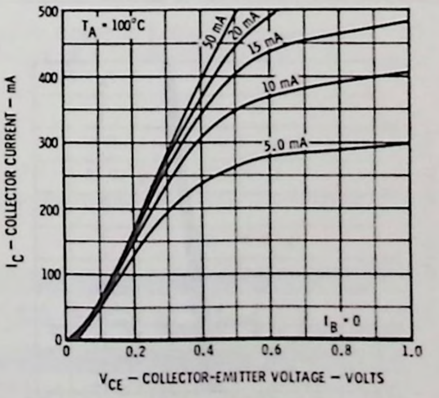








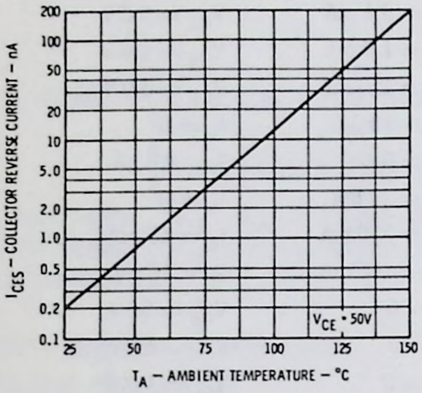




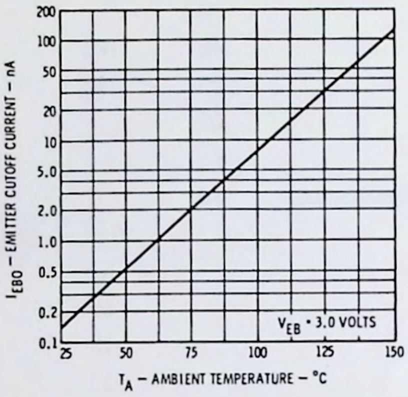
Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

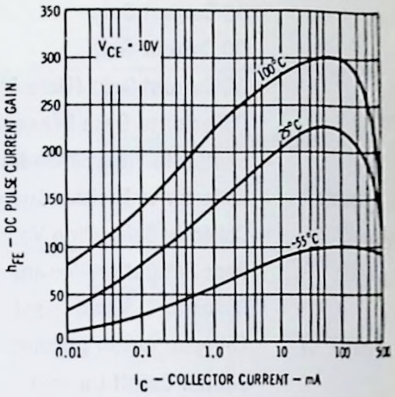
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



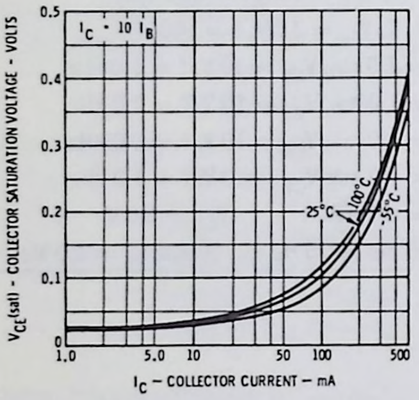
EMITTER CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



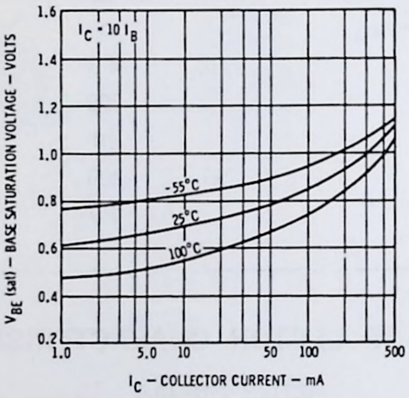
PULSE DC CURRENT GAIN VERSUS COLLECTOR CURRENT



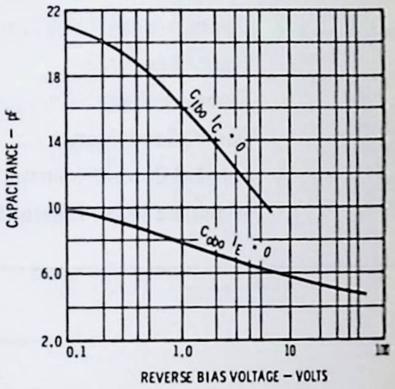
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



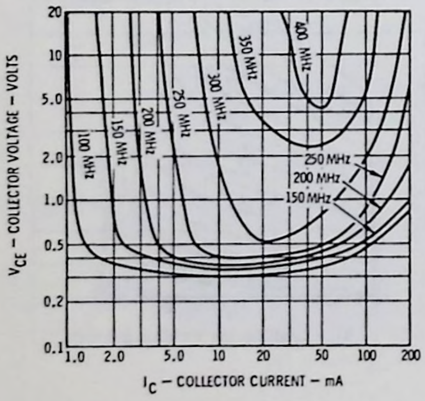
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



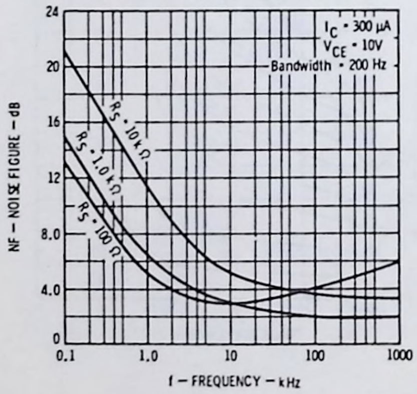
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



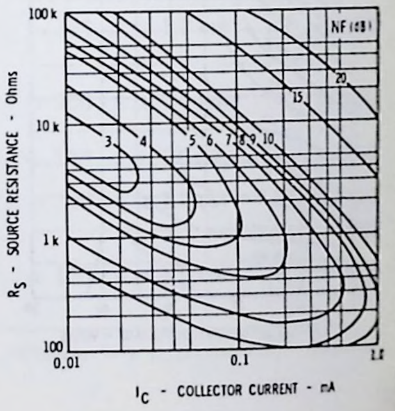
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



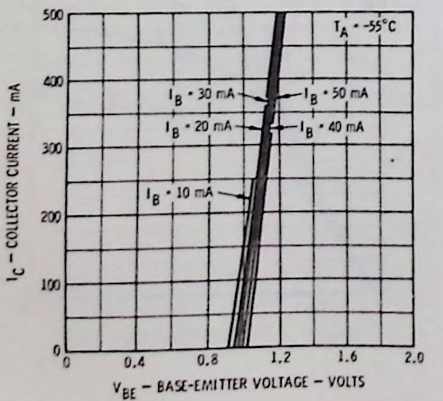
NARROW BAND NOISE FIGURE VERSUS FREQUENCY

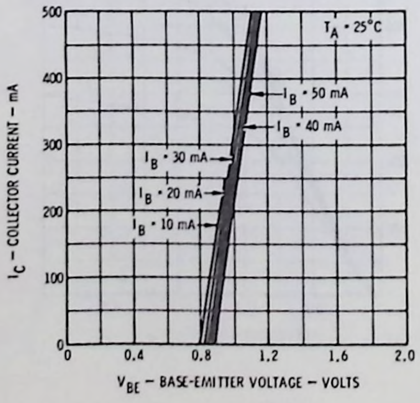


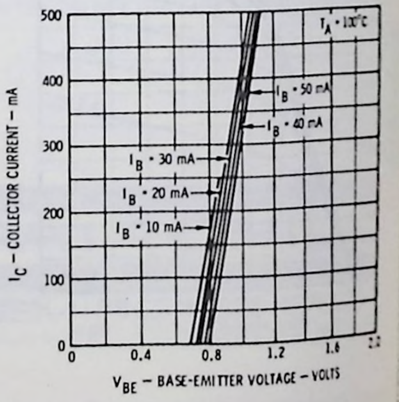
CONTOURS OF CONSTANT WIDE BAND NOISE FIGURE



TYPICAL BASE CHARACTERISTICS





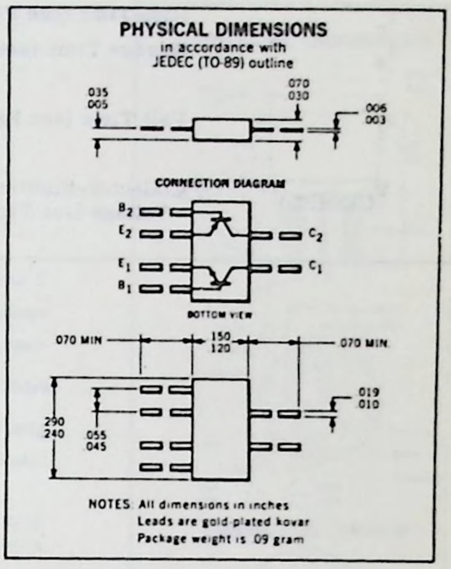


FT3838 · 2N3838

NPN-PNP GENERAL PURPOSE COMPLEMENTARY DUAL TYPE

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

ENERAL DESCRIPTION - The FT3838 and 2N3838 each contain an NPN-PNP Complementary Pair of Silicon lanar Triode Transistors designed primarily for switching and general purpose amplifier applications in ndustrial service.


PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-89) outline

NOTES: All dimensions in inches
Leads are gold-plated kovar
Package weight is .09 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

aximum Temperatures

Storage Temperature -65°C to +200°C

aximum Power Dissipation

		One Side	Both Sides
Total Dissipation at 25°C Case Temperature	(Notes 2 & 3)	0.7 Watt	1.4 Watts
at 25°C Ambient Temperature	(Notes 2 & 3)	0.25 Watt	0.35 Watt

aximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	600 mA
V_{C1-C2}	Collector 1 to Collector 2 Voltage	±120 Volts

ECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions (Note 6)
h_{FE}	DC Pulse Current Gain (Note 5)	100	300		$I_C = 150$ mA $V_{CE} = 10$ V
h_{FE}	DC Current Gain	35			$I_C = 100\ \mu A$ $V_{CE} = 10$ V
h_{FE}	DC Current Gain	75			$I_C = 10$ mA $V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	50			$I_C = 150$ mA $V_{CE} = 1.0$ V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.4	Volts	$I_C = 150$ mA (pulsed) $I_B = 15$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)	0.85	1.3	Volts	$I_C = 150$ mA (pulsed) $I_B = 15$ mA
I_{CEV}	Collector Cut-off Current		10	nA	$V_{CE} = 50$ V $V_{BE} = -0.5$ V
I_{BEV}	Base Cut-off Current		-10	nA	$V_{CE} = 50$ V $V_{BE} = -0.5$ V
BV_{CBO}	Collector to Base Breakdown Voltage	60		Volts	$I_C = 10\ \mu A$ $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5		Volts	$I_C = 0$ $I_E = 10\ \mu A$
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40		Volts	$I_C = 10$ mA (pulsed) $I_E = 0$
h_{fe}	High Frequency Current Gain (f = 100 Mc) (2N3838) only	2.0			$I_C = 20$ mA $V_{CE} = 10$ V
h_{fe}	High Frequency Current Gain (f = 100 Mc) (FT3838) only	2.0			$I_C = 50$ mA $V_{CE} = 20$ V
C_{obo}	Output Capacitance		8	pf	$I_E = 0$ $V_{CB} = 10$ V
h_{ie}	Input Resistance (f = 1.0 Kc)	1.5	9.0	K Ω	$I_C = 1.0$ mA $V_{CE} = 10$ V
h_{oe}	Output Conductance (f = 1.0 Kc)		50	µmho	$I_C = 1.0$ mA $V_{CE} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)	60	300		$I_C = 1.0$ mA $V_{CE} = 10$ V
NF	Spot Noise Figure (f = 1.0 Kc)		8	db	$I_C = 100\ \mu A$ $V_{CE} = 10$ V $R_S = 1.0$ KΩ

TES:

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These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

These ratings give a maximum junction temperature of 175°C and junction-to-ambient thermal resistance of 600°C/Watt (derating factor of 1.67 mW/°C) for one side; 428 °C/Watt (derating of 2.3 mW/°C) for both sides. Junction-to-case thermal resistance of 214 °C/Watt (derating factor of 4.67 mW/°C) for one side; 107 °C/Watt (derating factor of 9.3 mW/°C) for both sides.

Rating refers to a high current point where collector-to-emitter voltage is lowest.

Pulse Conditions = 300 µsec; Duty cycle = 1%.

Voltages and currents apply to the NPN triode. For the PNP triode the values are the same, but the signs are reversed.

This characteristic is the highest value of collector supply voltage which may be safely used with a resistive load switching circuit in which the collector current approaches 600 mA.

FAIRCHILD
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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
I_{CEV}(150°C)	Collector Cutoff Current		10	μA	V_{CE} = 50 V V_{BE} = -0.5 V
I_{EBO}	Emitter Cutoff Current		10	nA	V_{EB} = 3.0 V I_C = 0
t_d	Turn-On Delay Time (see Fig. 1)		10	nsec	I_C = 150 mA I_{B1} = 15 mA
t_r	Rise Time (see Fig. 1)		40	nsec	I_C = 150 mA I_{B1} = 15 mA
t_s	Storage Time (see Fig. 2)		250	nsec	I_C = 150 mA, I_{B1} = 15 mA, I_{B2} = -15 mA
t_f	Fall Time (see Fig. 2)		90	nsec	I_C = 150 mA, I_{B1} = 15 mA, I_{B2} = -15 mA
$V_{CEO(NL)}$	Collector-Emitter Nonlatching Voltage (see Fig. 3) (Note 7)	40		Volts	$I_{C(on)}$ = 600 mA, $I_{B(on)}$ = 120 mA, $I_{B(off)}$ = 0

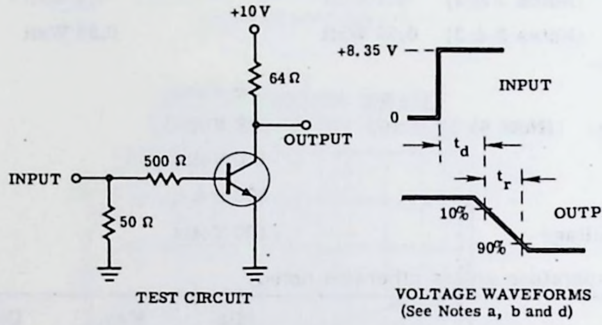

+10 V
64 Ω
OUTPUT
500 Ω
INPUT
50 Ω
TEST CIRCUIT
+8.35 V
0
INPUT
t_d
t_r
10%
90%
OUTPUT
VOLTAGE WAVEFORMS
(See Notes a, b and d)

FIGURE 1

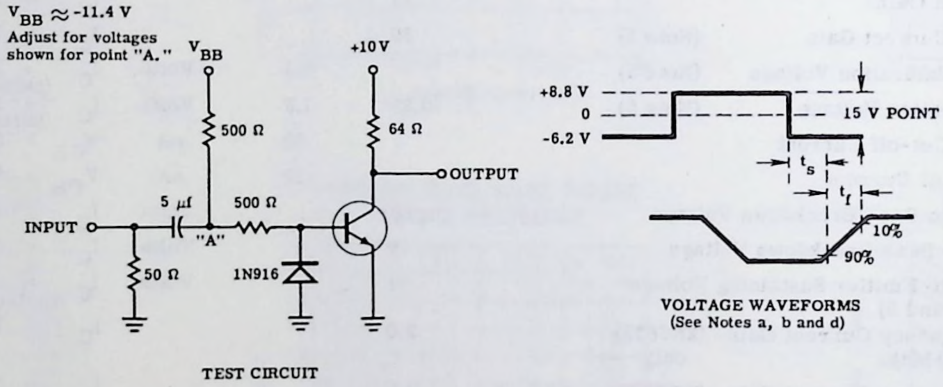

V_{BB} ≈ -11.4 V
Adjust for voltages shown for point "A."
V_{BB}
500 Ω
+10 V
64 Ω
OUTPUT
5 μf
500 Ω
"A"
INPUT
50 Ω
1N916
TEST CIRCUIT
+8.8 V
0
-6.2 V
15 V POINT "A"
t_s
t_f
10%
90%
VOLTAGE WAVEFORMS
(See Notes a, b and d)

FIGURE 2

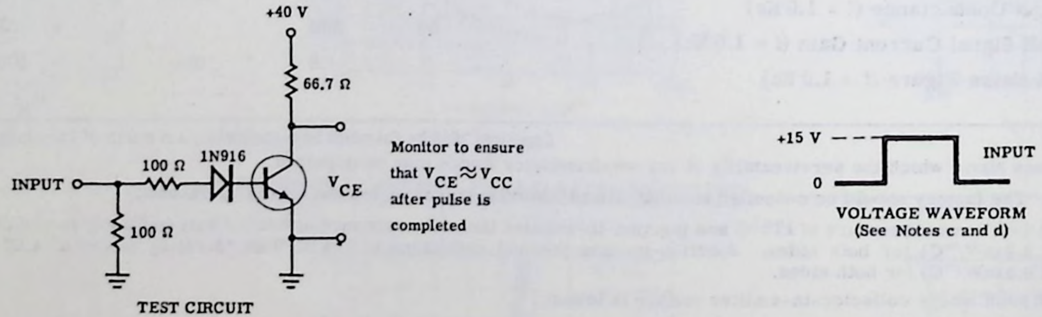

+40 V
66.7 Ω
100 Ω
1N916
INPUT
V_{CE}
100 Ω
TEST CIRCUIT
Monitor to ensure that $V_{CE} \approx V_{CC}$ after pulse is completed
+15 V
0
INPUT
VOLTAGE WAVEFORM
(See Notes c and d)

FIGURE 3 — COLLECTOR-EMITTER NONLATCHING VOLTAGE TEST CIRCUIT

NOTES:

a. The input waveforms are supplied by a generator with the following characteristics: For Figure 1, Z_{out} = 50 Ω, $t_r \leq 1$ nsec, PW ≥ 400 nsec, Duty Cycle ≤ 2%; for Figure 2, Z_{out} = 50 Ω, $t_r \leq 10$ nsec, PW = 10 μsec, Duty Cycle ≤ 2%.

b. The waveforms are monitored on an oscilloscope with the following characteristics: For Figure 1, $t_r \leq 1$ nsec, $R_{IN} \geq 100$ KΩ, $C_{IN} \leq 5$ pf; for Figure 2, $t_r \leq 5$ nsec, $R_{IN} \geq 100$ KΩ, $C_{IN} \leq 12$ pf.

c. The input waveform in Figure 3 has the following characteristics: PW ≤ 10 μsec, Duty Cycle ≤ 2%.

d. The signs and polarity symbols shown are for the N-P-N triode; the signs and polarity symbols are reversed for the P-N-P triode.

2N4017 · 2N4018 · 2N4019

DUAL PNP HIGH-GAIN, LOW-NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR II EPITAXIAL TRANSISTORS

- HIGH BREAKDOWN -- 80 VOLT LV_{CEO}
- HIGH CURRENT GAIN AT LOW COLLECTOR CURRENT --250 Min. @ 10uA
- GUARANTEED BETA @ -55 AND +100°C
- LOW NOISE -- 4.0 db Max. @ 100 cps; 8.0 db Max. @ 10 cps
- FLAT BETA FROM 1.0uA TO 50 mA

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 Sec Time Limit)	+300°C Maximum

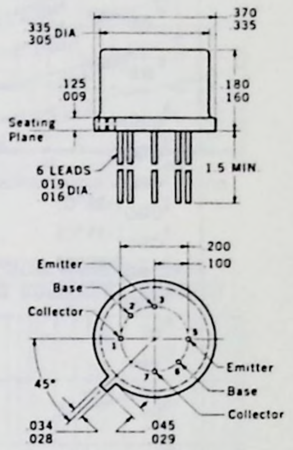
Maximum Power Dissipation

		One Side	Both Sides
Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.80 Watt	1.3 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.40 Watt	0.60 Watt

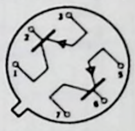
Maximum Voltages and Current for Each Transistor

			2N4017	2N4018	2N3019
V_{CBO}	Collector to Base Voltage		-80 Volts	-60 Volts	-45 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-80 Volts	-60 Volts	-45 Volts
V_{EBO}	Emitter to Base Voltage		-6.0 Volts	-6.0 Volts	-6.0 Volts
I_C	Collector Current		200 mA	200 mA	200 mA

PHYSICAL DIMENSIONS



CONNECTION DIAGRAM



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 1.08 grams

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	2N4017 Min.	2N4017 Max.	2N4018 Min.	2N4018 Max.	2N4019 Min.	2N4019 Max.	Units	Test Conditions
h_{FE}	**DC Current Gain**	60		60		180			I_C = 1.0 μA V_{CE} = -5.0 V
h_{FE}	**DC Current Gain**	100	350	100	500	250	500		I_C = 10 μA V_{CE} = -5.0 V
h_{FE}	DC Current Gain	100		100		250			I_C = 100 μA V_{CE} = -5.0 V
h_{FE}	DC Current Gain	100	500	100	600	250	600		I_C = 1.0 mA V_{CE} = -5.0 V
h_{FE}(100°C)	**DC Current Gain**		600		800		800		I_C = 1.0 mA V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	100		100		200			I_C = 10 mA V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	90		90		180			I_C = 50 mA V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	40		40		80			I_C = 50 mA V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Current Gain	40		40		100			I_C = 10 μA V_{CE} = -5.0 V
NF	Noise Figure		3.0		3.0		2.0	db	I_C = 20 μA V_{CE} = -5.0 V f = 1.0 Kc BW = 150 cps, R_S = 10 KΩ
NF	**Noise Figure**						8.0	db	**I_C = 20 μA V_{CE} = -5.0 V f = 10 cps, BW = 2.0 cps, R_s = 10 KOhm**
NF	**Noise Figure**		10		10		4.0	db	**I_C = 20 μA V_{CE} = -5.0 V f = 100 cps BW = 15 cps, R_s = 10 KOhm**

OTES:

- These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 437°C/Watt (derating factor of 2.3 mW/°C) for one side; 292°C/Watt (derating factor of 3.4 mW/°C) for both sides. Junction-to-case thermal resistance of 219°C/Watt (derating factor of 4.57 mW/°C) for one side; 135°C/Watt (derating factor of 7.4 mW/°C) for both sides.
- Rating refers to a high-current point where collector-to-emitter voltage is lowest.
- Pulse Conditions: length = 300 μsec; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

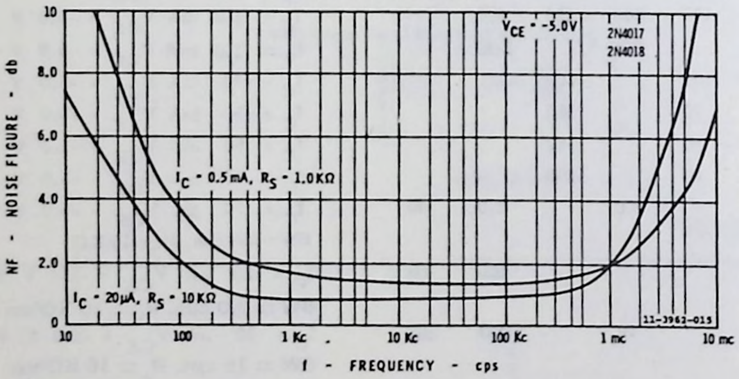
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

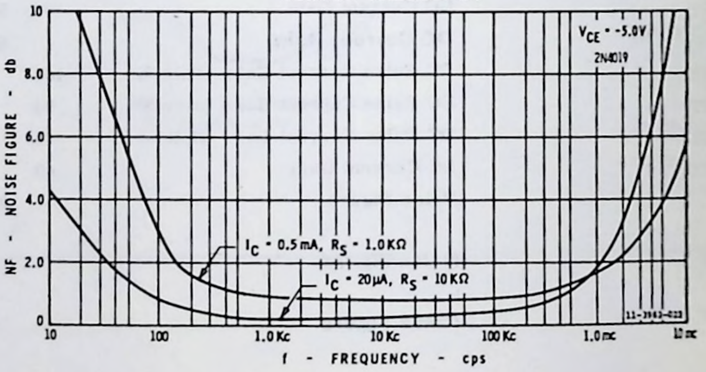
Symbol	Characteristic	2N4017 Min.	2N4017 Max.	2N4018 Min.	2N4018 Max.	2N4019 Min.	2N4019 Max.	Units	Test Conditions
BV_{CBO}	Collector to Base Breakdown Voltage	-80		-60		-45		Volts	I_C = 10 μA I_E = 0
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**−80**		**−60**		**−45**		**Volts**	**I_C = 5.0 mA** I_B = 0 (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		-6.0		-6.0		Volts	I_E = 10 μA I_C = 0
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		-0.25		-0.25		-0.25	Volts	I_C = 10 mA I_B = 0.5 mA
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		-0.4		-0.4		-0.4	Volts	I_C = 50 mA I_B = 5.0 mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, Note 5)		-0.9		-0.9		-0.9	Volts	I_C = 10 mA I_B = 0.5 mA
V_{BE}(sat)	Base Saturation Voltage (pulsed, Note 5)		-0.95		-0.95		-0.95	Volts	I_C = 50 mA I_B = 5.0 mA
I_{CBO}	Collector Cutoff Current		10					nA	I_E = 0 V_{CB} = -70 V
I_{CBO}	Collector Cutoff Current				10			nA	I_E = 0 V_{CB} = -50 V
I_{CBO}	Collector Cutoff Current						10	nA	I_E = 0 V_{CB} = -30 V
I_{CBO}(125°C)	Collector Cutoff Current		10					μA	I_E = 0 V_{CB} = -70 V
I_{CBO}(125°C)	Collector Cutoff Current				10			μA	I_E = 0 V_{CB} = -50 V
I_{CBO}(125°C)	Collector Cutoff Current						10	μA	I_E = 0 V_{CB} = -30 V
I_{EBO}	Emitter Cutoff Current		10		10		10	nA	I_C = 0 V_{EB} = -4.0 V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.0	8.0	2.0	8.0	2.5	8.0		I_C = 0.5 mA V_{CE} = -5.0 V
C_{obo}	Common-Base, Open-Circuit Output Capacitance		6.0		6.0		6.0	pf	I_E = 0 V_{CB} = -5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)	100	550	100	700	250	700		I_C = 1.0 mA V_{CE} = -5.0 V
h_{ie}	Input Resistance (f = 1.0 Kc)	2.5	17	2.5	20	6.0	20	Kohm.	I_C = 1.0 mA V_{CE} = -5.0 V
h_{oe}	Output Conductance (f = 1.0 Kc)	5.0	40	5.0	50	5.0	50	μmho	I_C = 1.0 mA V_{CE} = -5.0 V
h_{re}	Voltage Feedback Ratio (f = 1.0 Kc)		10		10		10	$x10^{-4}$	I_C = 1.0 mA V_{CE} = -5.0 V

TYPICAL ELECTRICAL CHARACTERISTICS

NOISE FIGURE VERSUS FREQUENCY

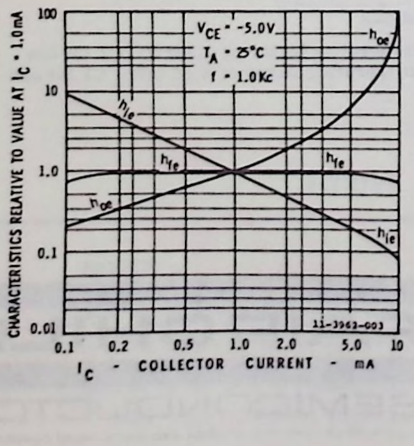


NOISE FIGURE VERSUS FREQUENCY

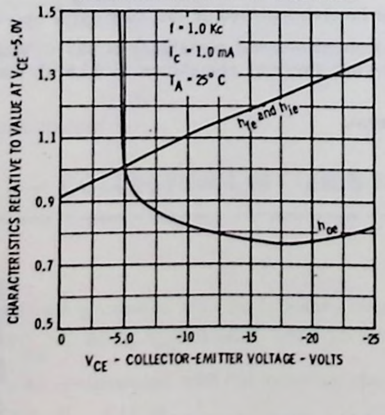


THESE CURVES APPLY TO ALL TYPES

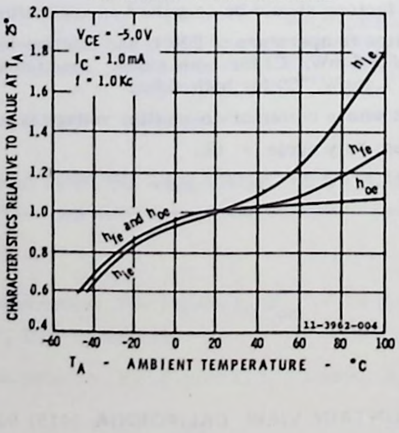
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



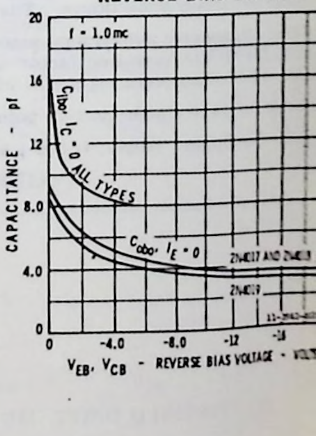
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE

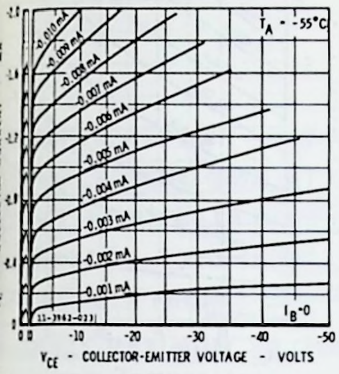


INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

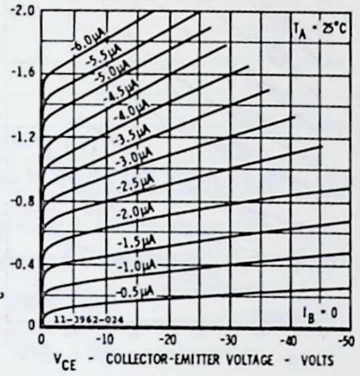


TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4017 AND 2N4018

COLLECTOR CHARACTERISTICS*



COLLECTOR CHARACTERISTICS



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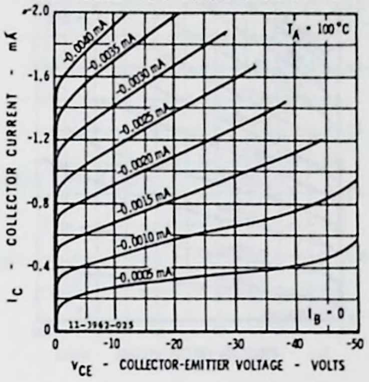

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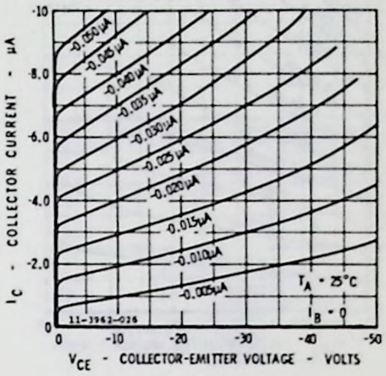

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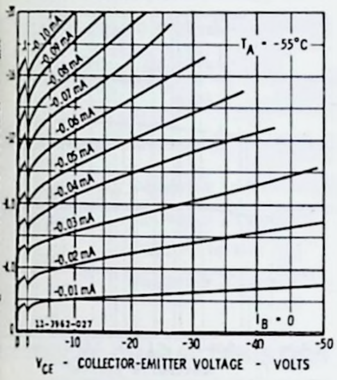

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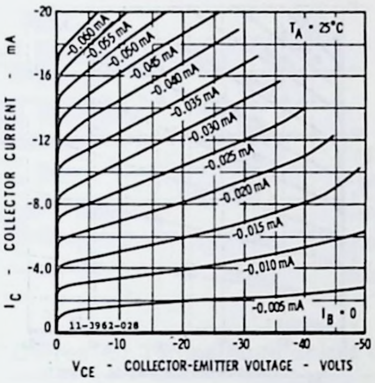

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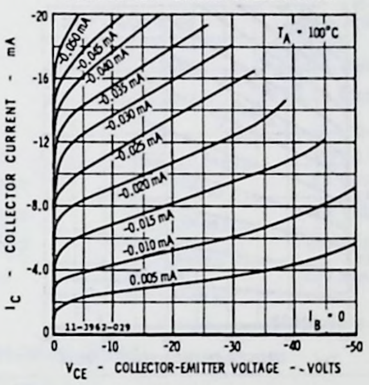
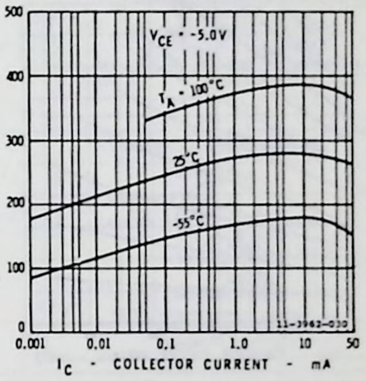
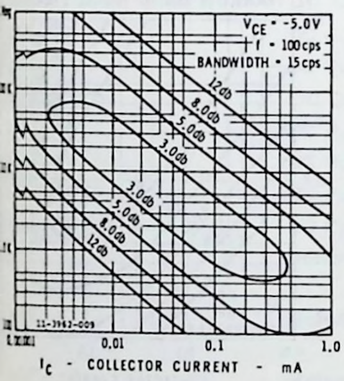


DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



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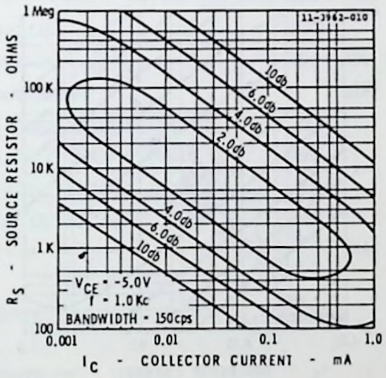
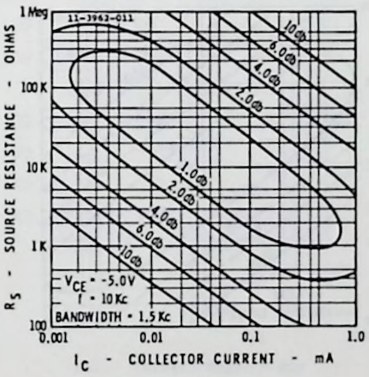
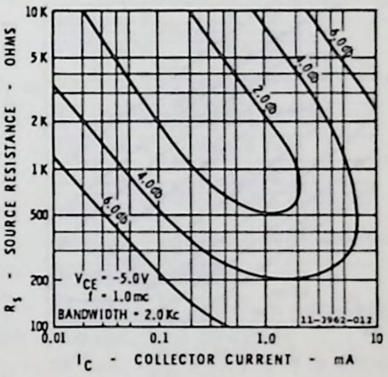


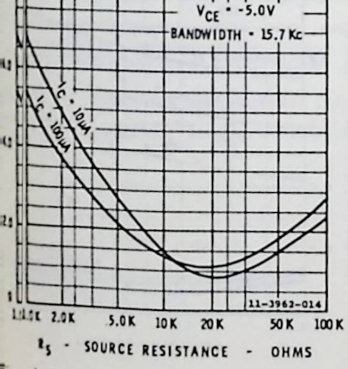
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



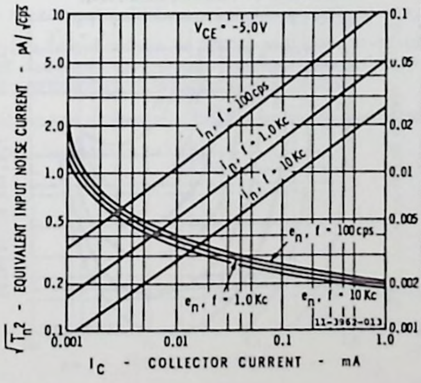
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



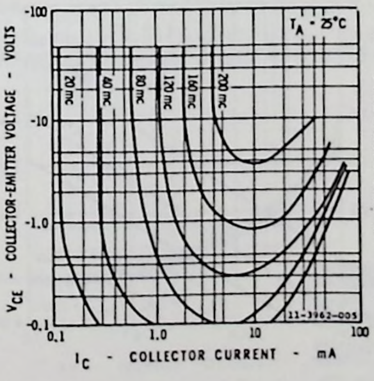
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



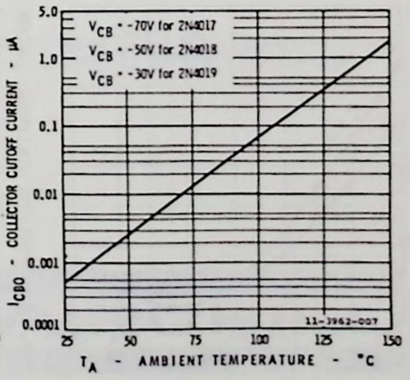
EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT VERSUS COLLECTOR CURRENT



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



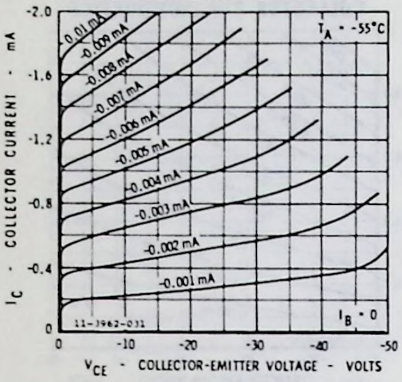
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



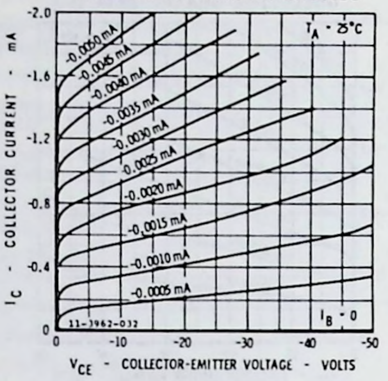
*Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4019

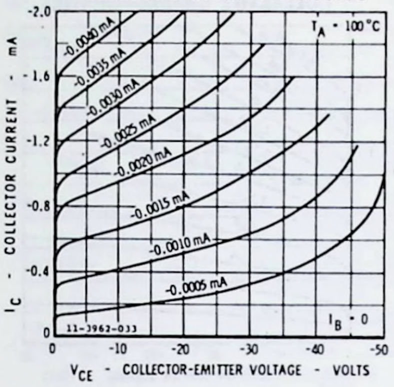
COLLECTOR CHARACTERISTICS *



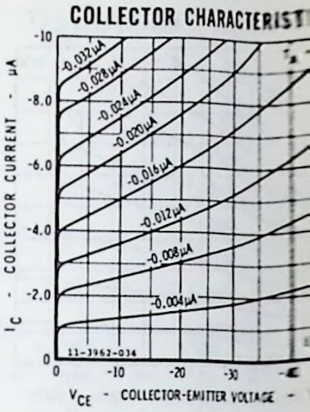
COLLECTOR CHARACTERISTICS



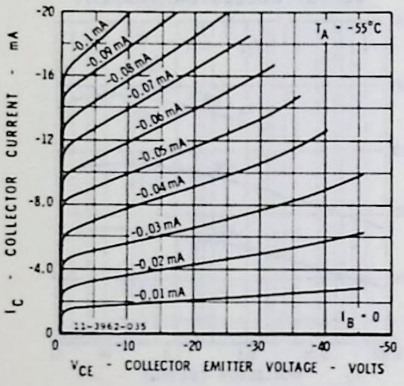
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTI



COLLECTOR CHARACTERISTICS *



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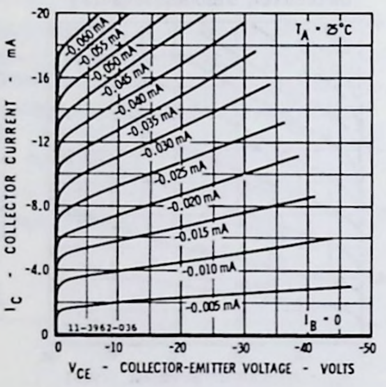

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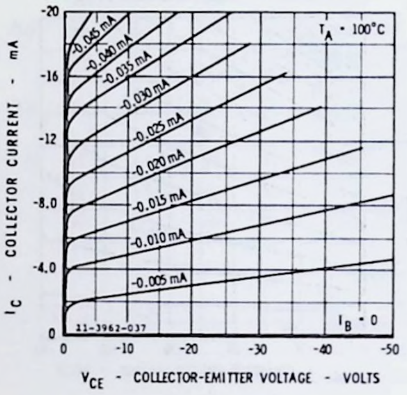
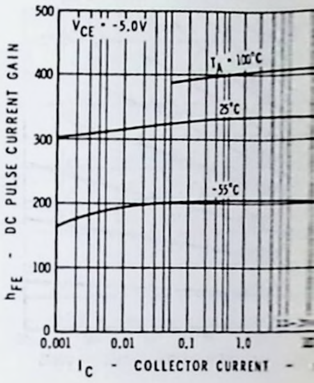
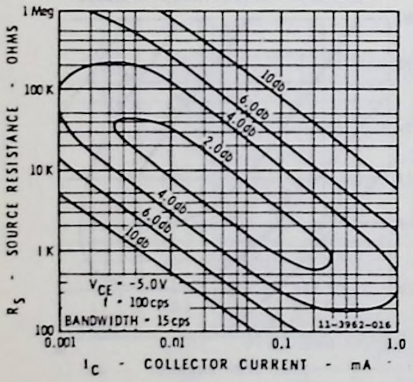


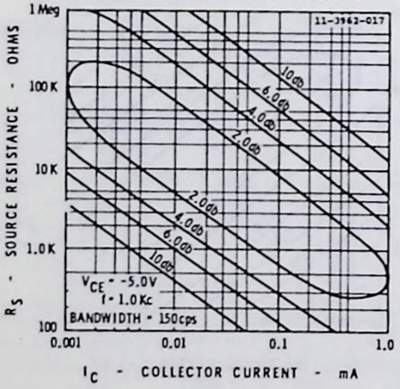
DC PULSE CURRENT GAI VERSUS COLLECTOR CURR



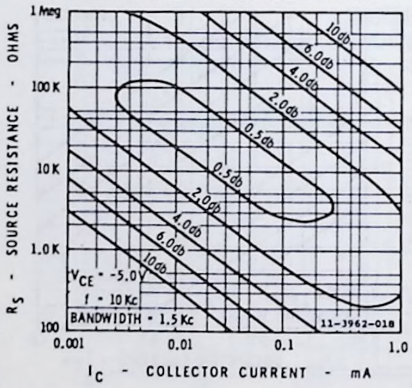
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



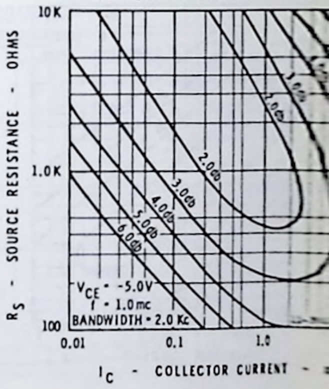
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



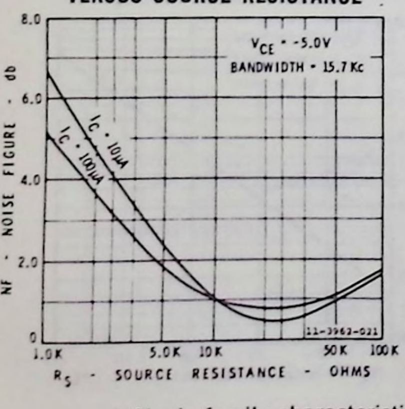
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



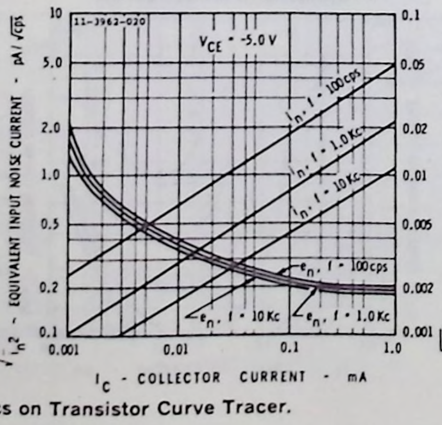
CONTOURS OF CONSTANT NARROW BAND NOISE FIGU



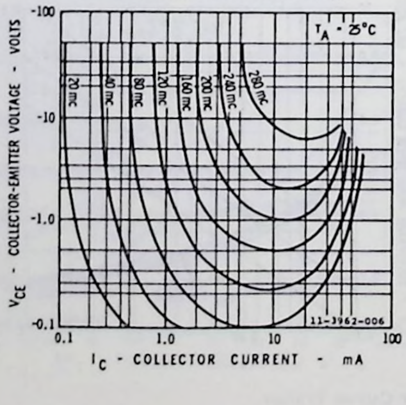
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



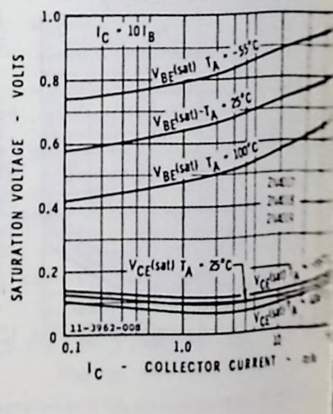
EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT VERSUS COLLECTOR CURRENT



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



COLLECTOR AND BASE SATURATION VOLTAGES VERSU COLLECTOR CURRENT

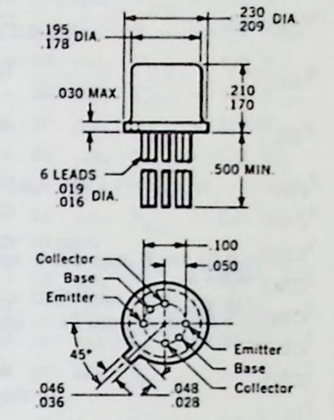


* Single family characteristics on Transistor Curve Tracer.

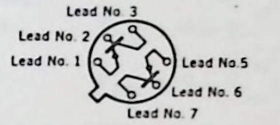
FT4017 • FT4018 • FT4019
DUAL PNP HIGH-GAIN, LOW-NOISE AMPLIFIERS
DIFFUSED SILICON PLANAR II EPITAXIAL TRANSISTORS

- HIGH BREAKDOWN -- 80 VOLT LV_{CEO}
- HIGH CURRENT GAIN AT LOW COLLECTOR CURRENT --250 Min. @ 10uA
- GUARANTEED BETA @ -55 AND +100°C
- LOW NOISE -- 4.0 db Max. @ 100 cps; 8.0 db Max. @ 10 cps
- FLAT BETA FROM 1.0uA TO 50 mA

PHYSICAL DIMENSIONS



CONNECTION DIAGRAM



BOTTOM VIEW

NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 0.62 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 Sec Time Limit)	+300°C Maximum

Maximum Power Dissipation

		One Side	Both Sides
Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.70 Watt	1.10 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.40 Watt	0.50 Watt

Maximum Voltages and Current for Each Transistor

			FT4017	FT4018	FT4019
V_{CBO}	Collector to Base Voltage		-80 Volts	-60 Volts	-45 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-80 Volts	-60 Volts	-45 Volts
V_{EBO}	Emitter to Base Voltage		-6.0 Volts	-6.0 Volts	-6.0 Volts
I_C	Collector Current		200 mA	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FT4017		FT4018		FT4019			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{FE}	**DC Current Gain**	**60**		**60**		**180**			**I_C = 1.0 μA V_{CE} = -5.0 V**
** h_{FE}	**DC Current Gain**	**100**	**350**	**100**	**500**	**250**	**500**		**I_C = 10 μA V_{CE} = -5.0 V**
h_{FE}	DC Current Gain	100		100		250			I_C = 100 μA V_{CE} = -5.0 V
h_{FE}	DC Current Gain	100	500	100	600	250	600		I_C = 1.0 mA V_{CE} = -5.0 V
h_{FE}(100°C)	**DC Current Gain**		**600**		**800**		**800**		**I_C = 1.0 mA V_{CE} = -5.0 V**
h_{FE}	DC Pulse Current Gain (Note 5)	100		100		200			I_C = 10 mA V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	90		90		180			I_C = 50 mA V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	40		40		80			I_C = 50 mA V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Current Gain	40		40		100			I_C = 10 μA V_{CE} = -5.0 V
NF	Noise Figure		3.0		3.0		2.0	db	I_C = 20 μA V_{CE} = -5.0 V f = 1.0 Kc BW = 150 cps, R_S = 10 KΩ
NF	**Noise Figure**						**8.0**	**db**	**I_C = 20 μA V_{CE} = -5.0 V f = 10 cps, BW = 2.0 cps, R_S = 10 KOhm**
NF	**Noise Figure**		10		10		**4.0**	**db**	**I_C = 20 μA V_{CE} = -5.0 V f = 100 cps BW = 15 cps, R_S = 10 KOhm**

Additional Electrical Characteristics on page 2

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 437°C/Watt (derating factor of 2.3 mW/°C) for one side; 350°C/Watt (derating factor of 2.8 mW/°C) for both sides. Junction-to-case thermal resistance of 250°C/Watt (derating factor of 4.0 mW/°C) for one side; 159°C/Watt (derating factor of 6.2 mW/°C) for both sides.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

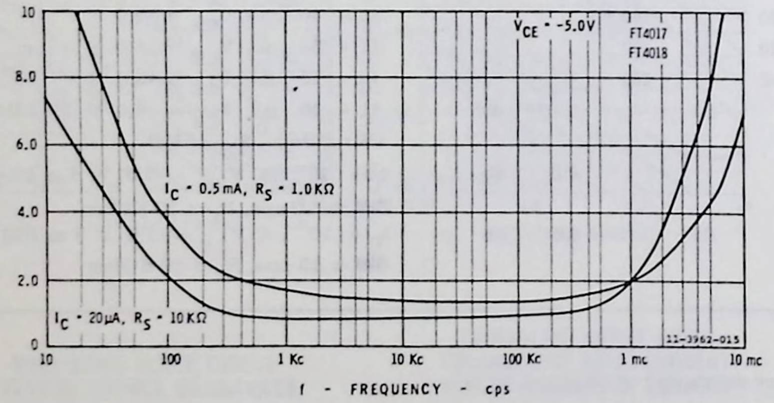
FAIRCHILD TRANSISTORS FT4017 • FT4018 • FT4019

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

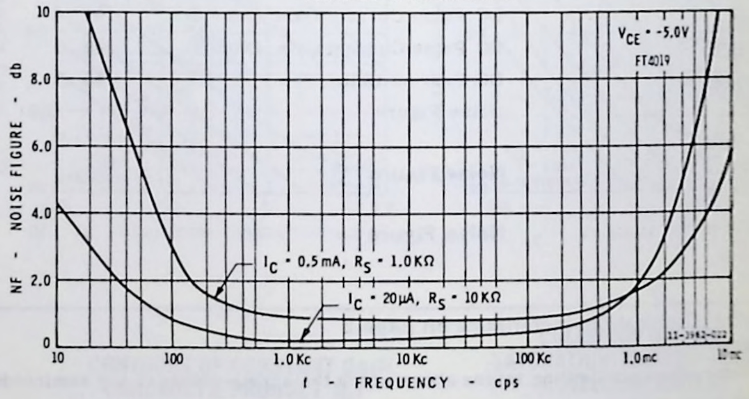
Symbol	Characteristic	FT4017 Min.	FT4017 Max.	FT4018 Min.	FT4018 Max.	FT4019 Min.	FT4019 Max.	Units	Test Conditions
BV_{CBO}	Collector to Base Breakdown Voltage	-80		-60		-45		Volts	I_C = 10 μA I_E = 0
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**−80**		**−60**		**−45**		**Volts**	**I_C = 5.0 mA** I_B = 0 (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		-6.0		-6.0		Volts	I_E = 10 μA I_C = 0
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		-0.25		-0.25		-0.25	Volts	I_C = 10 mA I_B = 0.5
V_{CE}(sat)	Collector Saturation Voltage (pulsed, Note 5)		-0.4		-0.4		-0.4	Volts	I_C = 50 mA I_B = 5.0
V_{BE}(sat)	Base Saturation Voltage (pulsed, Note 5)		-0.9		-0.9		-0.9	Volts	I_C = 10 mA I_B = 0.5
V_{BE}(sat)	Base Saturation Voltage (pulsed, Note 5)		-0.95		-0.95		-0.95	Volts	I_C = 50 mA I_B = 5.0
I_{CBO}	Collector Cutoff Current		10					nA	I_E = 0 V_{CB} = -70 V
I_{CBO}	Collector Cutoff Current				10			nA	I_E = 0 V_{CB} = -50 V
I_{CBO}	Collector Cutoff Current						10	nA	I_E = 0 V_{CB} = -30 V
I_{CBO}(125 C)	Collector Cutoff Current		10					μA	I_E = 0 V_{CB} = -70 V
I_{CBO}(125 C)	Collector Cutoff Current				10			μA	I_E = 0 V_{CB} = -50 V
I_{CBO}(125 C)	Collector Cutoff Current						10	μA	I_E = 0 V_{CB} = -30 V
I_{EBO}	Emitter Cutoff Current		10		10		10	nA	I_C = 0 V_{EB} = -4.0 V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.0	8.0	2.0	8.0	2.5	8.0		I_C = 0.5 mA V_{CE} = -5.0 V
C_{obo}	Common-Base, Open-Circuit Output Capacitance		6.0		6.0		6.0	pf	I_E = 0 V_{CB} = -5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)	100	550	100	700	250	700		I_C = 1.0 mA V_{CE} = -5.0 V
h_{ie}	Input Resistance (f = 1.0 Kc)	2.5	17	2.5	20	6.0	20	Kohm.	I_C = 1.0 mA V_{CE} = -5.0 V
h_{oe}	Output Conductance (f = 1.0 Kc)	5.0	40	5.0	50	5.0	50	μmho	I_C = 1.0 mA V_{CE} = -5.0 V
h_{re}	Voltage Feedback Ratio (f = 1.0 Kc)		10		10		10	$x10^{-4}$	I_C = 1.0 mA V_{CE} = -5.0 V

TYPICAL ELECTRICAL CHARACTERISTICS

NOISE FIGURE VERSUS FREQUENCY

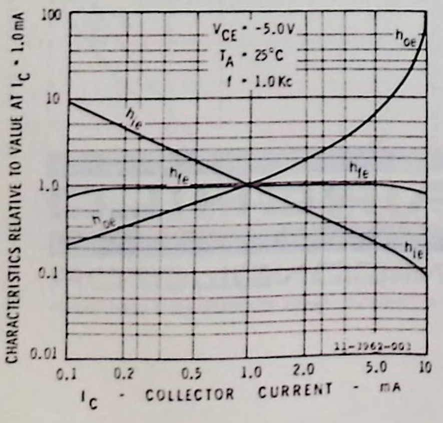


NOISE FIGURE VERSUS FREQUENCY

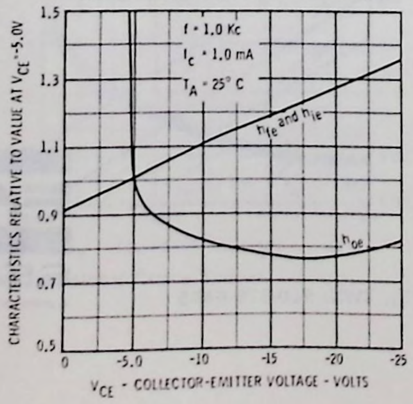


THESE CURVES APPLY TO ALL TYPES

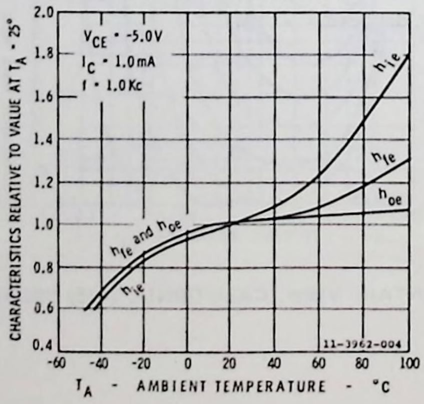
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



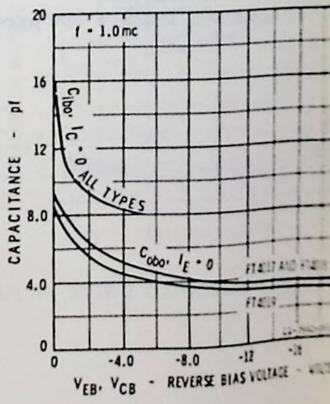
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



FAIRCHILD TRANSISTORS 2N4020 THROUGH 2N4025

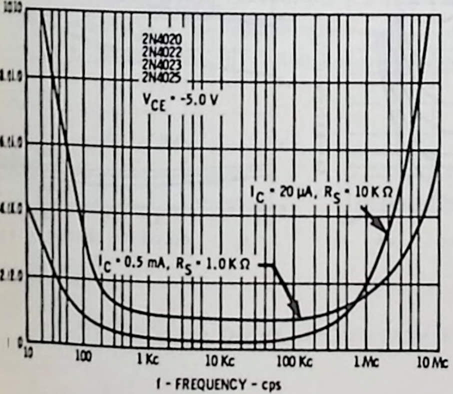
ELECTRICAL CHARACTERISTICS
(25°C Free Air Temperature unless otherwise noted)

		2N4021 **2N4024**		2N4020 2N4022 **2N4023** 2N4025				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions	
h_{FE}	**DC Current Gain**	**60**		**180**			$I_C = 1.0\ \mu A$	$V_{CE} = -5.0$ V
h_{FE}	**DC Current Gain**	**100**	**350**	**250**	**500**		$I_C = 10\ \mu A$	$V_{CE} = -5.0$ V
h_{FE}(-55°C)	DC Current Gain	40		100			$I_C = 10\ \mu A$	$V_{CE} = -5.0$ V
h_{FE}	**DC Current Gain**	100	400	250	550		$I_C = 100\ \mu A$	$V_{CE} = -5.0$ V
h_{FE}	DC Current Gain	100	500	250	600		$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{FE}(100°C)	DC Current Gain		**600**		**800**		$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{FE}	DC Pulse Current Gain (Note 6)	100		200			$I_C = 10$ mA	$V_{CE} = -5.0$ V
h_{FE}	DC Pulse Current Gain (Note 6)	90		180			$I_C = 50$ mA	$V_{CE} = -5.0$ V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 6)	40		80			$I_C = 50$ mA	$V_{CE} = -5.0$ V
NF	Noise Figure		3.0		2.0	db	$I_C = 20\ \mu A$, $V_{CE} = -5.0$ V, f = 1.0 Kc, BW = 150 cps, $R_S = 10\ K\Omega$	
NF	**Noise Figure**				**8.0**	**db**	$I_C = 20\ \mu A$, $V_{CE} = -5.0$ V, **f = 10 cps,** **BW = 2.0 cps, R_s = 10 Kohm**	
NF	**Noise Figure**		10		**4.0**	**db**	$I_C = 20\ \mu A$, $V_{CE} = -5.0$ V, **f = 100 cps,** **BW = 15 cps, R_s = 10 Kohm**	
V_{CE}(sat)	Collector Saturation Voltage		-0.25		-0.25	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{CE}(sat)	Collector Saturation Voltage (Note 6)		-0.4		-0.4	Volts	$I_C = 50$ mA (pulsed)	$I_B = 5.0$ mA
V_{BE}(sat)	Base Saturation Voltage		-0.9		-0.9	Volts	$I_C = 10$ mA	$I_B = 0.5$ mA
V_{BE}(sat)	Base Saturation Voltage (Note 6)		-0.95		-0.95	Volts	$I_C = 50$ mA (pulsed)	$I_B = 5.0$ mA
C_{obo}	Common-Base, Open-Circuit Output Capacitance		6.0		6.0	pf	$I_E = 0$	$V_{CB} = -5.0$ V
C_{ibo}	Common-Base, Open-Circuit Input Capacitance		15		15	pf	$I_C = 0$	$V_{EB} = -0.5$ V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.0	8.0	2.5	8.0		$I_C = 0.5$ mA	$V_{CE} = -5.0$ V
h_{ie}	Input Resistance (f = 1.0 Kc)	2.5	17	6.0	20	KOhm	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{oe}	Output Conductance (f = 1.0 Kc)	5.0	40	5.0	50	μmho	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{re}	Reverse Voltage Feedback Ratio (f = 1.0 Kc)		10		10	$x10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = -5.0$ V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)	100	550	250	700		$I_C = 1.0$ mA	$V_{CE} = -5.0$ V

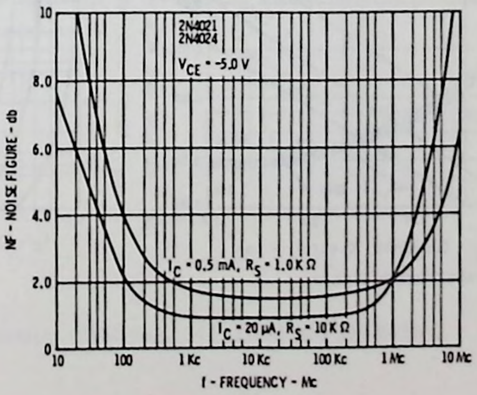
		2N4020 **2N4023**		2N4021 2N4022 **2N4024** 2N4025				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions	
I_{CBO}	Collector Cutoff Current		10			nA	$I_E = 0$	$V_{CB} = -30$ V
I_{CBO}	Collector Cutoff Current				10	nA	$I_E = 0$	$V_{CB} = -50$ V
I_{CBO}(125°C)	Collector Cutoff Current		10			μA	$I_E = 0$	$V_{CB} = -30$ V
I_{CBO}(125°C)	Collector Cutoff Current				10	μA	$I_E = 0$	$V_{CB} = -50$ V
I_{EBO}	Emitter Cutoff Current		10		10	nA	$I_C = 0$	$V_{EB} = -4.0$ V
BV_{CBO}	Collector to Base Breakdown Voltage	-45		-60		Volts	$I_E = 0$	$I_C = 10\ \mu A$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** Voltage (Notes 4 and 5)	**—45**		**—60**		**Volts**	$I_C = 5.0$ mA (pulsed)	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		-6.0		Volts	$I_C = 0$	$I_E = 10\ \mu A$

TYPICAL ELECTRICAL CHARACTERISTICS

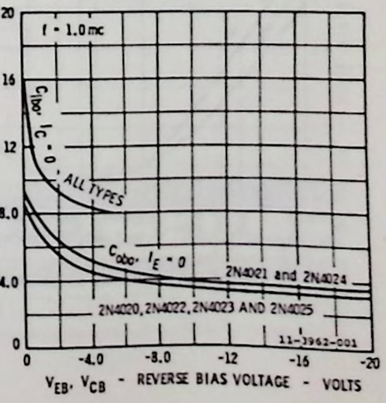
NOISE FIGURE VERSUS FREQUENCY



NOISE FIGURE VERSUS FREQUENCY



INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



ELECTRICAL CHARACTERISTICS

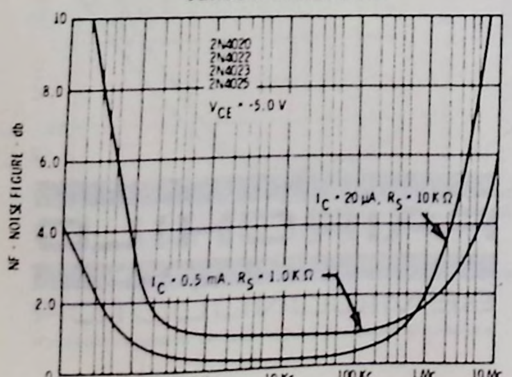
(25°C Free Air Temperature unless otherwise noted)

		2N4021 2N4024		2N4020 2N4022 2N4023 2N4025			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions
h_{FE}	**DC Current Gain**	60		180			$I_C = 1.0\ \mu A$, V_{CE} = -5.0 V
h_{FE}	**DC Current Gain**	100	350	250	500		$I_C = 10\ \mu A$, V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Current Gain	40		100			I_C = 10 µA, V_{CE} = -5.0 V
h_{FE}	**DC Current Gain**	100	400	250	550		I_C = 100 µA, V_{CE} = -5.0 V
h_{FE}	DC Current Gain	100	500	250	600		I_C = 1.0 mA, V_{CE} = -5.0 V
h_{FE}(100°C)	DC Current Gain		600		800		$I_C = 1.0$ mA, V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 6)	100		200			I_C = 10 mA, V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 6)	90		180			I_C = 50 mA, V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 6)	40		80			I_C = 50 mA, V_{CE} = -5.0 V
NF	Noise Figure		3.0		2.0	db	I_C = 20 µA, V_{CE} = -5.0 V, f = 1.0 Kc, BW = 150 cps, R_S = 10 KΩ
NF	**Noise Figure**				8.0	db	I_C = 20 µA, V_{CE} = -5.0 V, **f = 10 cps, BW = 2.0 cps, R_S = 10 Kohm**
NF	**Noise Figure**		10		4.0	db	I_C = 20 µA, V_{CE} = -5.0 V, **f = 100 cps, BW = 15 cps, R_S = 10 Kohm**
V_{CE}(sat)	Collector Saturation Voltage		-0.25		-0.25	Volts	I_C = 10 mA, I_B = 0.5 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 6)		-0.4		-0.4	Volts	I_C = 50 mA (pulsed), I_B = 5.0 mA
V_{BE}(sat)	Base Saturation Voltage		-0.9		-0.9	Volts	I_C = 10 mA, I_B = 0.5 mA
V_{BE}(sat)	Base Saturation Voltage (Note 6)		-0.95		-0.95	Volts	I_C = 50 mA (pulsed), I_B = 5.0 mA
C_{obo}	Common-Base, Open-Circuit Output Capacitance		6.0		6.0	pf	I_E = 0, V_{CB} = -5.0 V
C_{ibo}	Common-Base, Open-Circuit Input Capacitance		15		15	pf	I_C = 0, V_{EB} = -0.5 V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.0	8.0	2.5	8.0		I_C = 0.5 mA, V_{CE} = -5.0 V
h_{ie}	Input Resistance (f = 1.0 Kc)	2.5	17	6.0	20	KOhm	I_C = 1.0 mA, V_{CE} = -5.0 V
h_{oe}	Output Conductance (f = 1.0 Kc)	5.0	40	5.0	50	µmho	I_C = 1.0 mA, V_{CE} = -5.0 V
h_{re}	Reverse Voltage Feedback Ratio (f = 1.0 Kc)		10		10	$x10^{-4}$	I_C = 1.0 mA, V_{CE} = -5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)	100	550	250	700		I_C = 1.0 mA, V_{CE} = -5.0 V

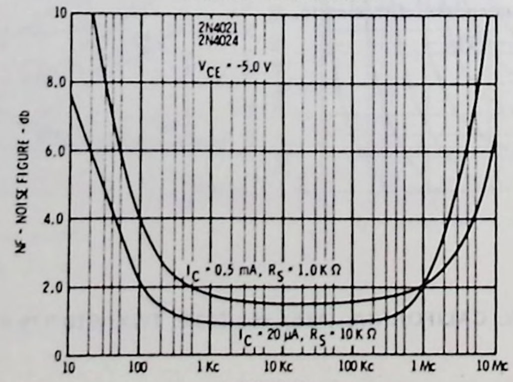
		2N4020 2N4023		2N4021 2N4022 2N4024 2N4025			
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions
I_{CBO}	Collector Cutoff Current		10			nA	I_E = 0, V_{CB} = -30 V
I_{CBO}	Collector Cutoff Current				10	nA	I_E = 0, V_{CB} = -50 V
I_{CBO}(125°C)	Collector Cutoff Current		10			µA	I_E = 0, V_{CB} = -30 V
I_{CBO}(125°C)	Collector Cutoff Current				10	µA	I_E = 0, V_{CB} = -50 V
I_{EBO}	Emitter Cutoff Current		10		10	nA	I_C = 0, V_{EB} = -4.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	-45		-60		Volts	I_E = 0, I_C = 10 µA
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** Voltage (Notes 4 and 5)	**−45**		**−60**		**Volts**	**$I_C = 5.0$ mA** (pulsed), I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		-6.0		Volts	I_C = 0, I_E = 10 µA

TYPICAL ELECTRICAL CHARACTERISTICS

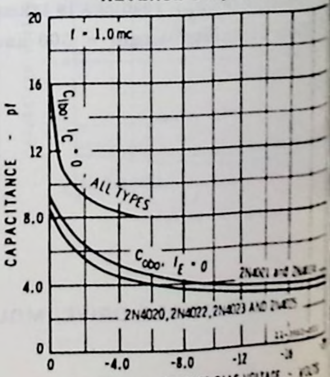
NOISE FIGURE VERSUS FREQUENCY



NOISE FIGURE VERSUS FREQUENCY

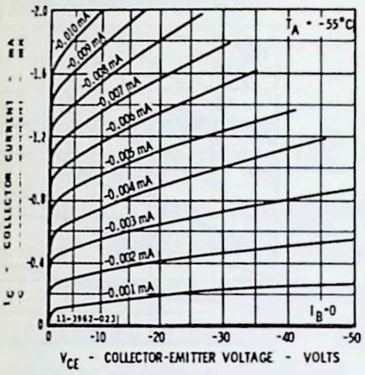


INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

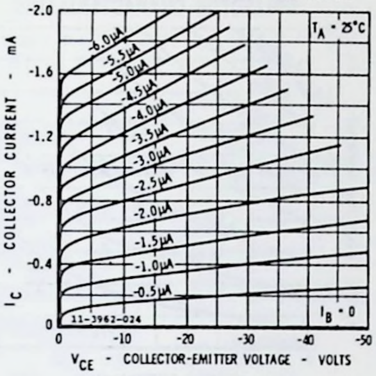


TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4021 AND 2N4024

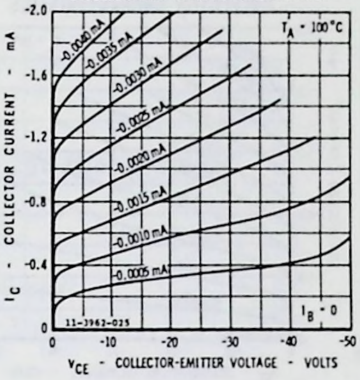
COLLECTOR CHARACTERISTICS*



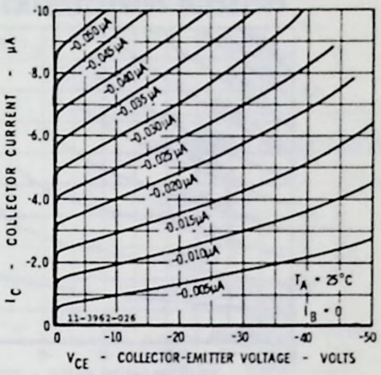
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



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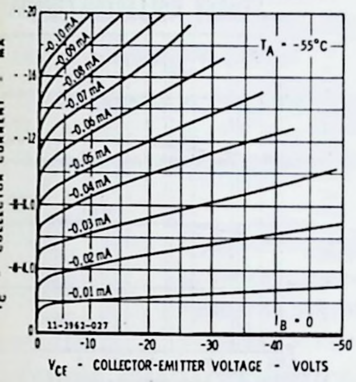

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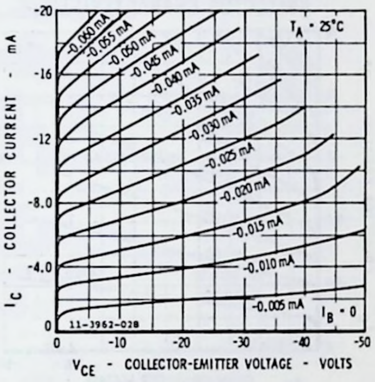
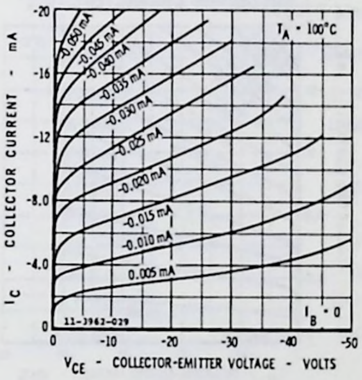
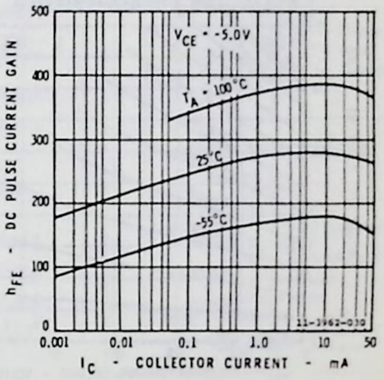


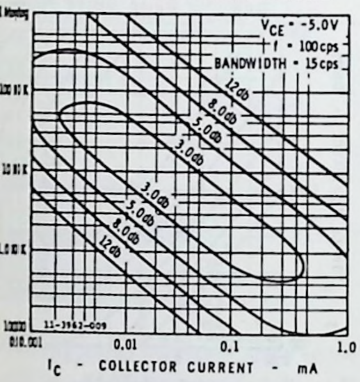
COLLECTOR CHARACTERISTICS*



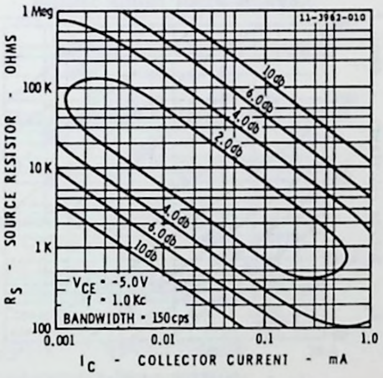
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



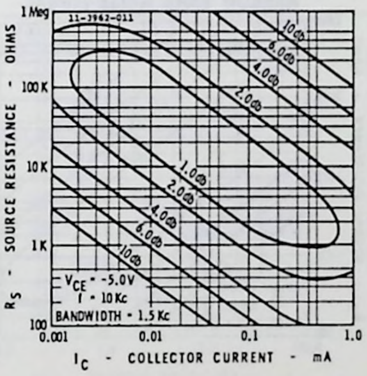
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



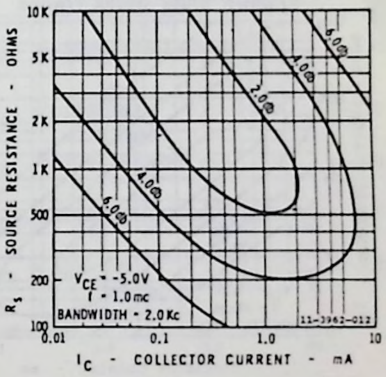
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



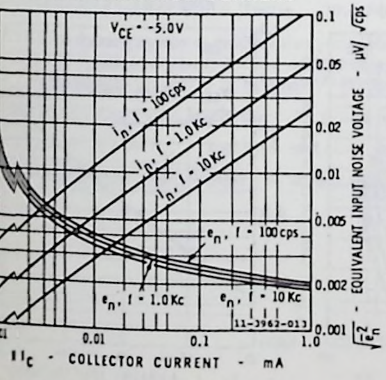
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



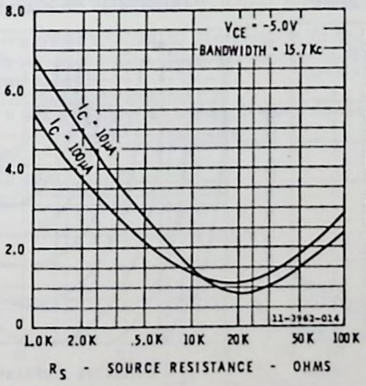
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



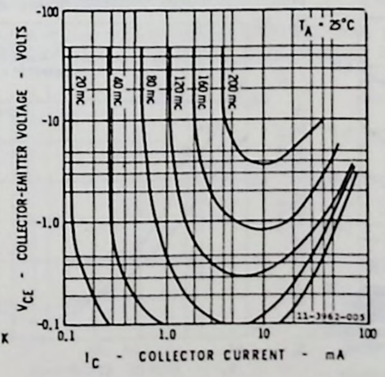
EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT VERSUS COLLECTOR CURRENT



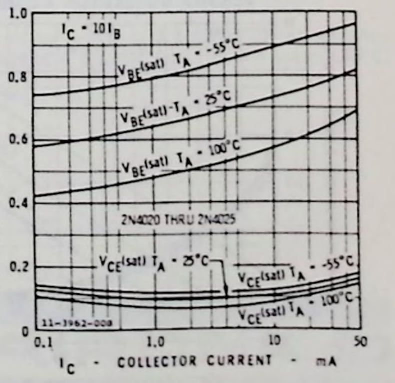
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



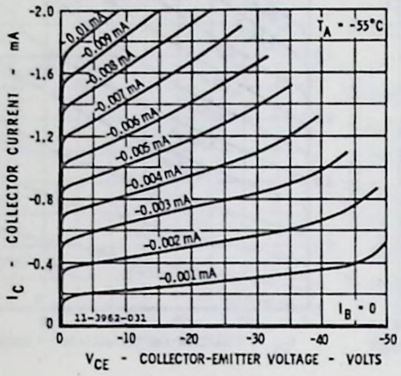
COLLECTOR AND BASE SATURATION VOLTAGES VERSUS COLLECTOR CURRENT



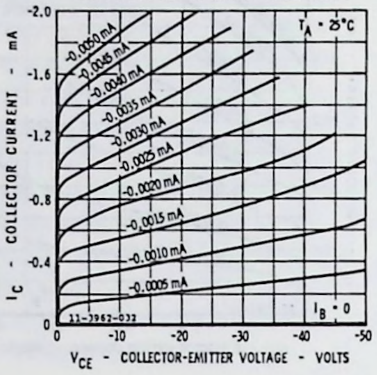
Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4020, 2N4022, 2N4023 AND 2N4025

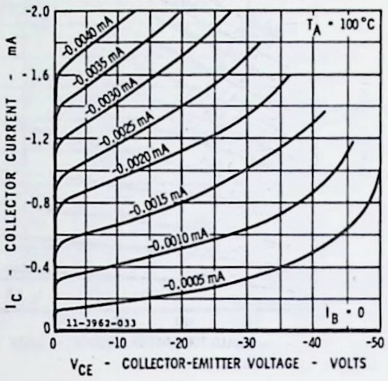
COLLECTOR CHARACTERISTICS*



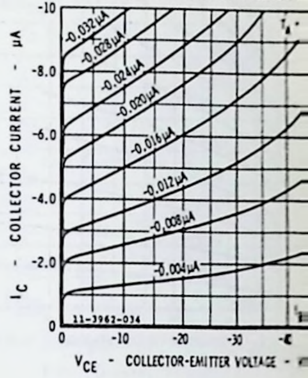
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTI



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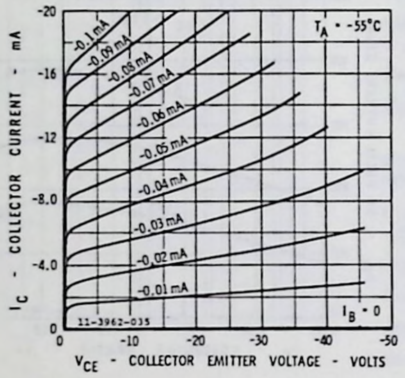

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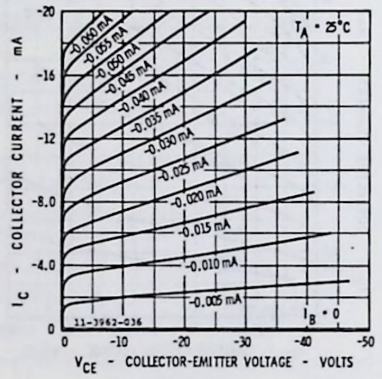
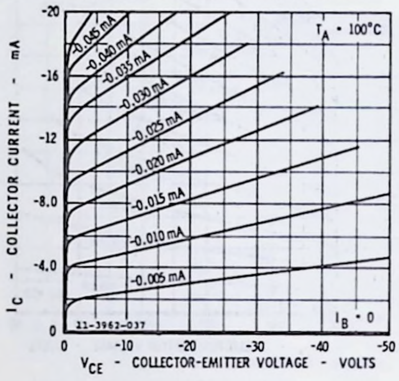
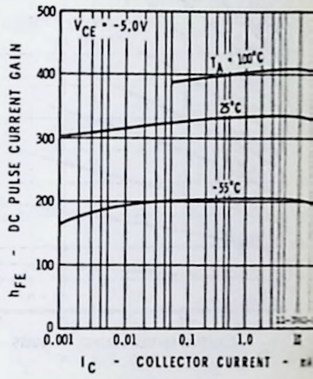


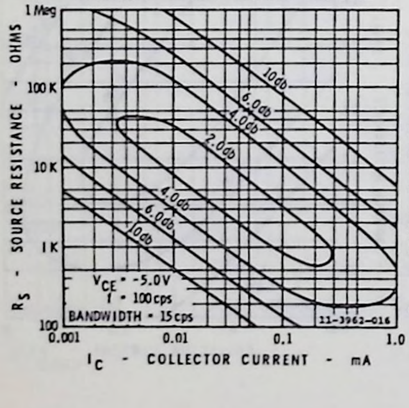
COLLECTOR CHARACTERISTICS*



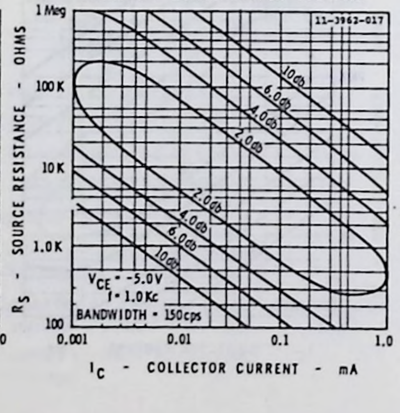
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRE



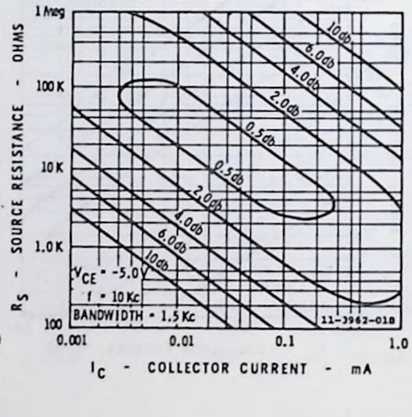
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



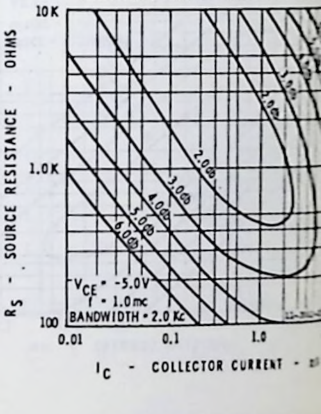
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



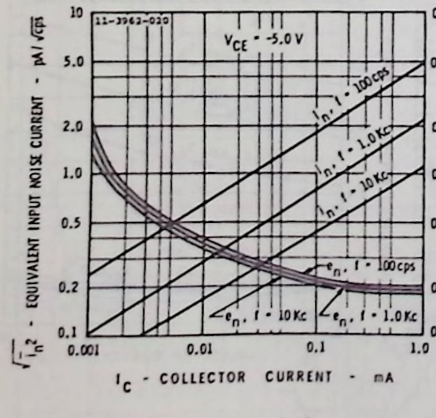
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



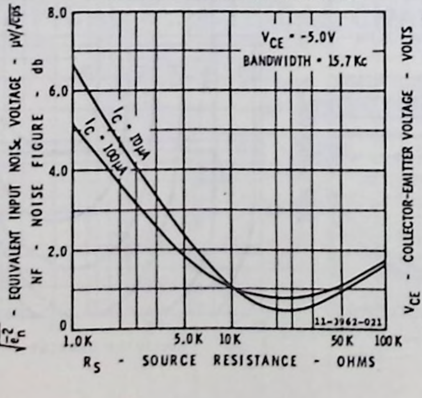
CONTOURS OF CONSTANT NARROW BAND NOISE FIGU



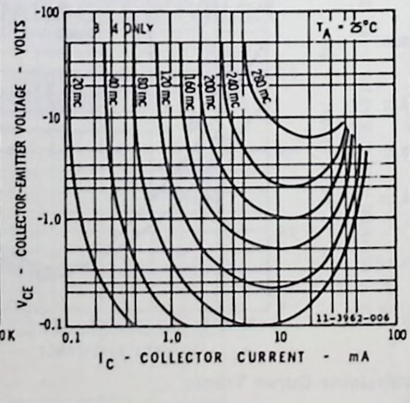
EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT VERSUS COLLECTOR CURRENT



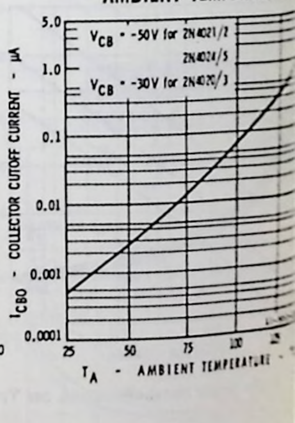
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



* Single family characteristics on Transistor Curve Tracer.

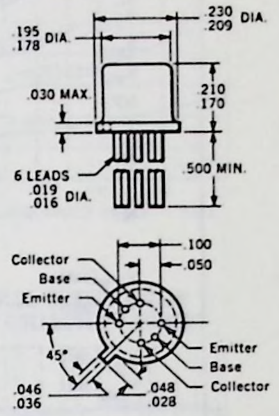
FT4020 THROUGH FT4025

PNP HIGH-GAIN, LOW-NOISE DIFFERENTIAL AMPLIFIERS

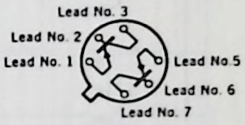
DIFFUSED SILICON PLANAR II EPITAXIAL TRANSISTORS

- HIGH BREAKDOWN -- 45 AND 60 VOLT LV_{CEO}
- HIGH CURRENT GAIN AT LOW COLLECTOR CURRENT -- 250 Min. @ 10 uA
- GUARANTEED BETA AT -55 AND +100°C
- 10% BETA MATCH FROM 100μA TO 1.0 mA
- LOW NOISE -- 4.0 db Max. @ 100 cps; 8.0 db Max. @ 10 cps
- FLAT BETA FROM 1.0 uA TO 50 mA

PHYSICAL DIMENSIONS



CONNECTION DIAGRAM



BOTTOM VIEW

NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is 0.62 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	+300°C Maximum

Maximum Power Dissipation

		One Side	Both Sides
Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	0.70 Watt	1.10 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.40 Watt	0.50 Watts

Maximum Voltages and Current for each Transistor

			FT4021 FT4022 FT4024 FT4025	FT4020 FT4023
V_{CBO}	Collector to Base Voltage		-60 Volts	-45 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	-60 Volts	-45 Volts
V_{EBO}	Emitter to Base Voltage		-6.0 Volts	-6.0 Volts
I_C	Collector Current		200 mA	200 mA

MATCHING CHARACTERISTICS

25°C Free Air Temperature unless otherwise noted)

		FT4020 FT4021 FT4022		FT4023 FT4024 FT4025				
Symbol	Characteristic	Min.	Max.	Min.	Max.	Units	Test Conditions	
*$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** (Note 5)	0.8	1.0	**0.9**	**1.0**		I_C = 100 μA to 1.0 mA	V_{CE} = -5.0 V
*$\|V_{BE1} - V_{BE2}\|$	**Base-Emitter Voltage Differential**		5.0		3.0	mV	I_C = 100 μA	V_{CE} = -5.0 V
$\|V_{BE1} - V_{BE2}\|$	**Base-Emitter Voltage Differential**		10		**5.0**	mV	I_C = 100 μA to 1.0 mA	V_{CE} = -5.0 V
$\|\Delta(V_{BE1} - V_{BE2})\|$	Base-Emitter Voltage Differential Change (T_A = -55°C to +25°C)		1.6		0.8	mV	I_C = 100 μA	V_{CE} = -5.0 V
$\|\Delta(V_{BE1} - V_{BE2})\|$	Base-Emitter Voltage Differential Change (T_A = 25°C to +125°C)		2.0		1.0	mV	I_C = 100 μA	V_{CE} = -5.0 V

†NOTE: These Numerals Apply to the Fairchild **FACT** Program.

*NOTE: **FACT** Program End-Point Measurement Parameter.

OTES:

1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 437°C/Watt (derating factor of 2.3 mW/°C) for one side; 350°C/Watt (derating factor of 2.8 mW/°C) for both sides. Junction-to-case thermal resistance of 250°C/Watt (derating factor of 4.0 mW/°C) for one side; 159°C/Watt (derating factor of 6.2 mW/°C) for both sides.
4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.
6) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

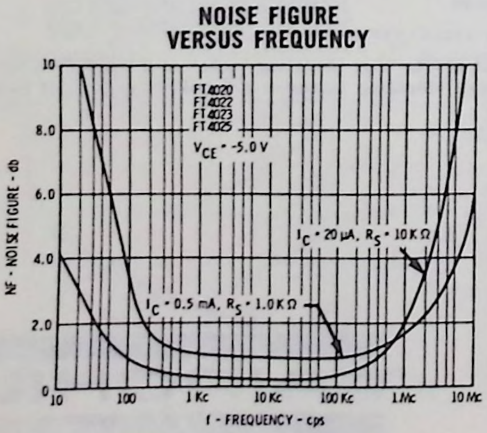
ELECTRICAL CHARACTERISTICS

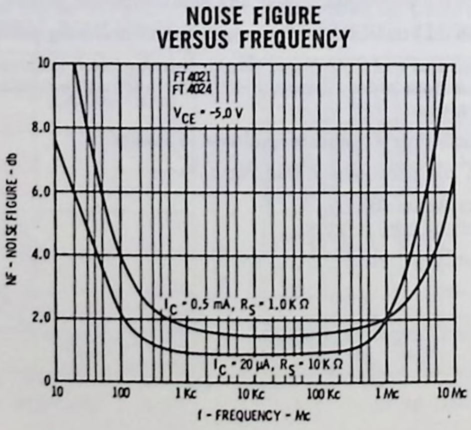
(25°C Free Air Temperature unless otherwise noted)

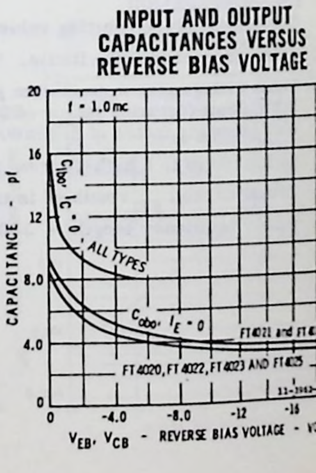
Symbol	Characteristic	FT4021 FT4024 Min.	Max.	FT4020 FT4022 FT4023 FT4025 Min.	Max.	Units	Test Conditions
h_{FE}	**DC Current Gain**	**60**		**180**			I_C = 1.0 μA V_{CE} = -5.0 V
h_{FE}	**DC Current Gain**	**100**	**350**	**250**	**500**		I_C = 10 μA V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Current Gain	40		100			I_C = 10 μA V_{CE} = -5.0 V
h_{FE}	**DC Current Gain**	100	400	250	550		I_C = 100 μA V_{CE} = -5.0 V
h_{FE}	DC Current Gain	100	500	250	600		I_C = 1.0 mA V_{CE} = -5.0 V
h_{FE}(100°C)	DC Current Gain		**600**		**800**		I_C = 1.0 mA V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 6)	100		200			I_C = 10 mA V_{CE} = -5.0 V
h_{FE}	DC Pulse Current Gain (Note 6)	90		180			I_C = 50 mA V_{CE} = -5.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 6)	40		80			I_C = 50 mA V_{CE} = -5.0 V
NF	Noise Figure		3.0		2.0	db	I_C = 20 μA, V_{CE} = -5.0 V, f = 1.0 Kc, BW = 150 cps, R_S = 10 K
NF	**Noise Figure**				**8.0**	**db**	I_C = 20 μA, V_{CE} = -5.0 V, **f = 10 cps,** **BW = 2.0 cps, R_s = 10 Kohm**
NF	**Noise Figure**		10		**4.0**	**db**	I_C = 20 μA, V_{CE} = -5.0 V, **f = 100 cps,** **BW = 15 cps, R_s = 10 Kohm**
V_{CE}(sat)	Collector Saturation Voltage		-0.25		-0.25	Volts	I_C = 10 mA I_B = 0.5 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 6)		-0.4		-0.4	Volts	I_C = 50 mA (pulsed) I_B = 5.0 mA
V_{BE}(sat)	Base Saturation Voltage		-0.9		-0.9	Volts	I_C = 10 mA I_B = 0.5 mA
V_{BE}(sat)	Base Saturation Voltage (Note 6)		-0.95		-0.95	Volts	I_C = 50 mA (pulsed) I_B = 5.0 mA
C_{obo}	Common-Base, Open-Circuit Output Capacitance		6.0		6.0	pf	I_E = 0 V_{CB} = -5.0 V
C_{ibo}	Common-Base, Open-Circuit Input Capacitance		15		15	pf	I_C = 0 V_{EB} = -0.5 V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	2.0	8.0	2.5	8.0		I_C = 0.5 mA V_{CE} = -5.0 V
h_{ie}	Input Resistance (f = 1.0 Kc)	2.5	17	6.0	20	KOhm	I_C = 1.0 mA V_{CE} = -5.0 V
h_{oe}	Output Conductance (f = 1.0 Kc)	5.0	40	5.0	50	μmho	I_C = 1.0 mA V_{CE} = -5.0 V
h_{re}	Reverse Voltage Feedback Ratio (f = 1.0 Kc)		10		10	$x10^{-4}$	I_C = 1.0 mA V_{CE} = -5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 Kc)	100	550	250	700		I_C = 1.0 mA V_{CE} = -5.0 V

Symbol	Characteristic	FT4020 FT4023 Min.	Max.	FT4021 FT4022 FT4024 FT4025 Min.	Max.	Units	Test Conditions
I_{CBO}	Collector Cutoff Current		10			nA	I_E = 0 V_{CB} = -30 V
I_{CBO}	Collector Cutoff Current				10	nA	I_E = 0 V_{CB} = -50 V
I_{CBO}(125°C)	Collector Cutoff Current		10			μA	I_E = 0 V_{CB} = -30 V
I_{CBO}(125°C)	Collector Cutoff Current				10	μA	I_E = 0 V_{CB} = -50 V
I_{EBO}	Emitter Cutoff Current		10		10	nA	I_C = 0 V_{EB} = -4.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	-45		-60		Volts	I_E = 0 I_C = 10 μA
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** Voltage (Notes 4 and 5)	**−45**		**−60**		**Volts**	I_C = 5.0 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-6.0		-6.0		Volts	I_C = 0 I_E = 10 μA

TYPICAL ELECTRICAL CHARACTERISTICS

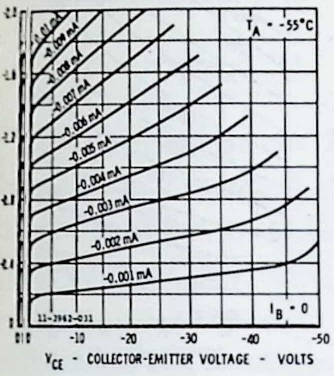

NOISE FIGURE VERSUS FREQUENCY


NOISE FIGURE VERSUS FREQUENCY

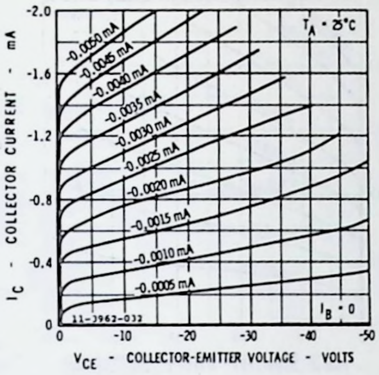

INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

TYPICAL ELECTRICAL CHARACTERISTICS FOR FT4020, FT4022, FT4023 AND FT4025

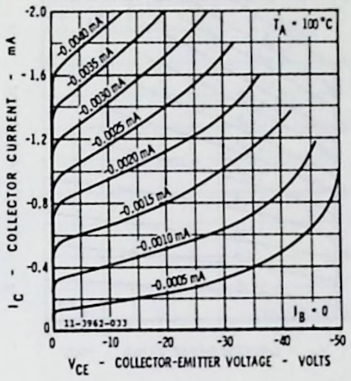
COLLECTOR CHARACTERISTICS*



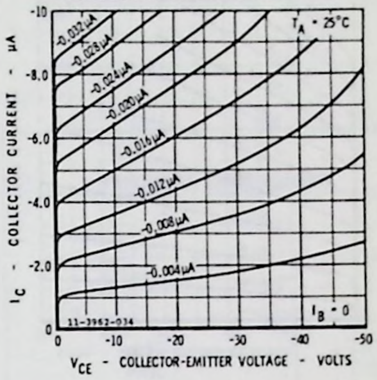
COLLECTOR CHARACTERISTICS



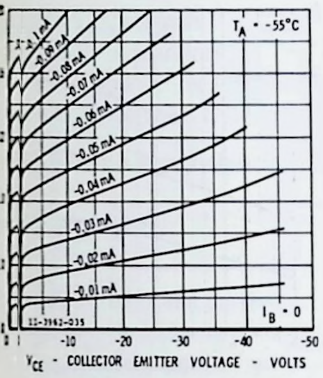
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS*



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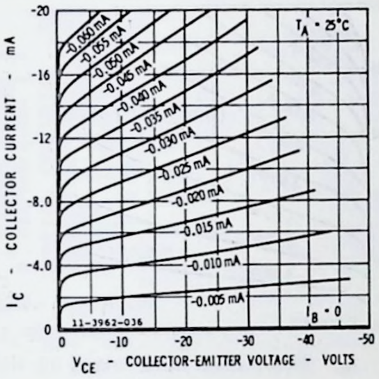

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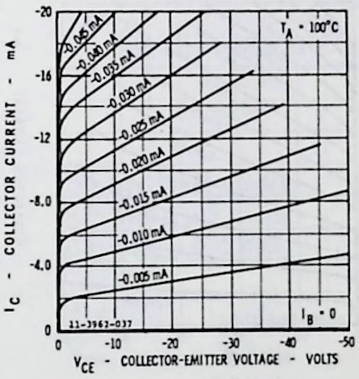
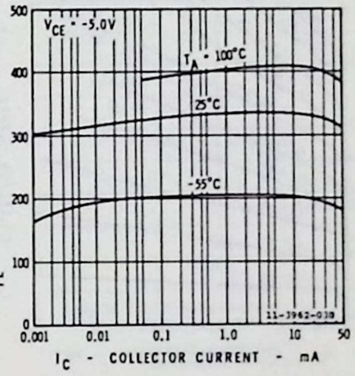
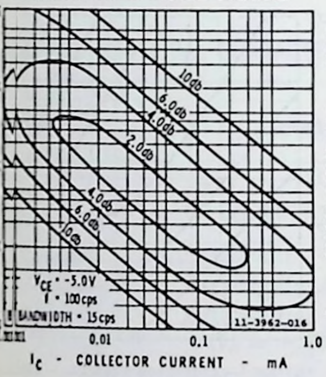


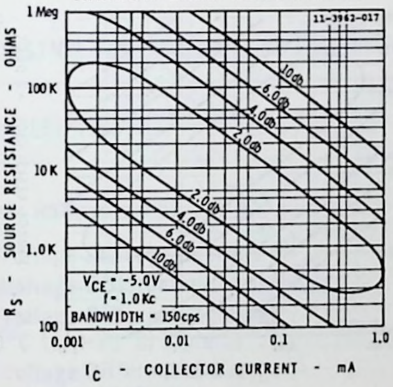
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



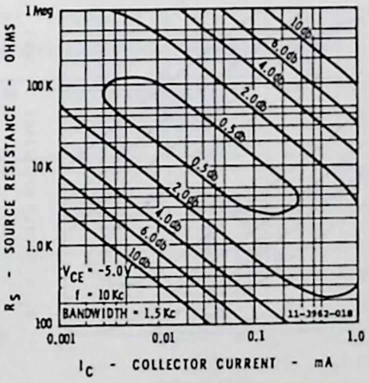
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



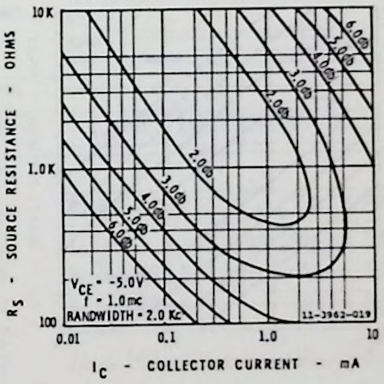
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



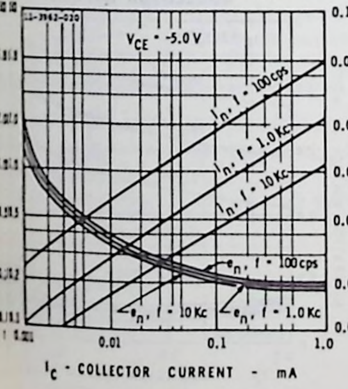
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



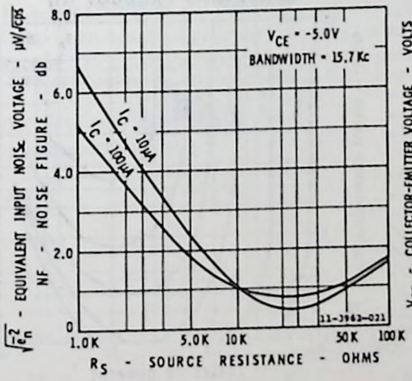
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



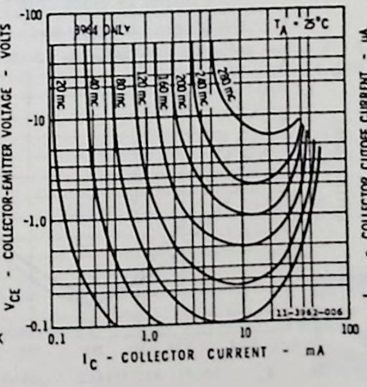
EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT VERSUS COLLECTOR CURRENT



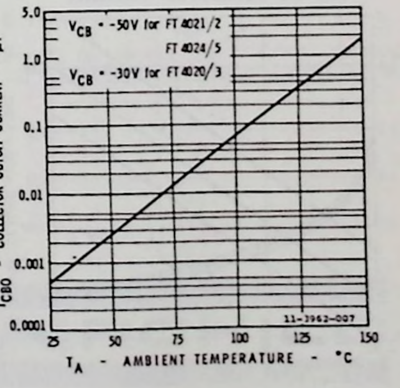
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



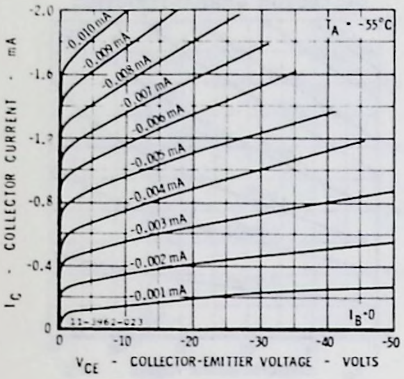
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



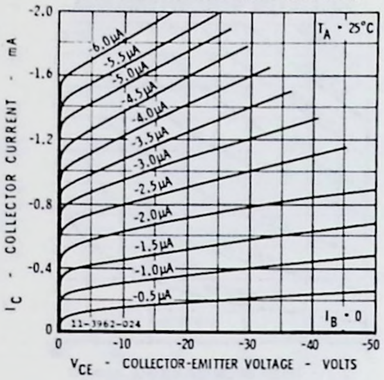
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS FOR FT4021 AND FT4024

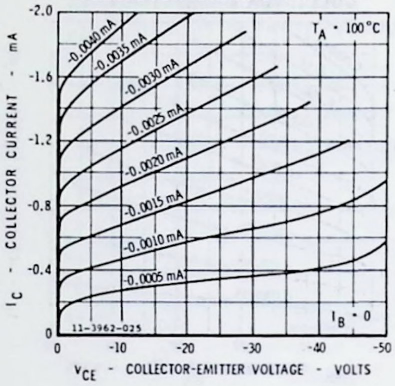
COLLECTOR CHARACTERISTICS*



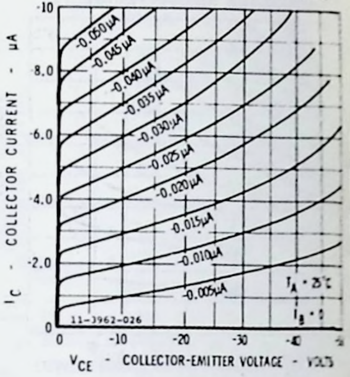
COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



COLLECTOR CHARACTERISTICS



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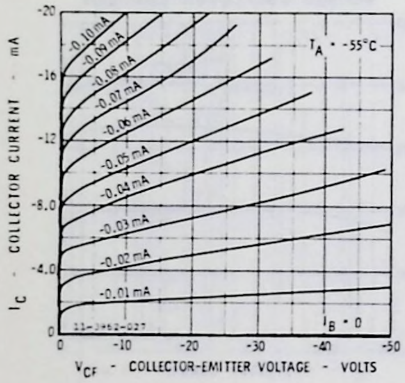

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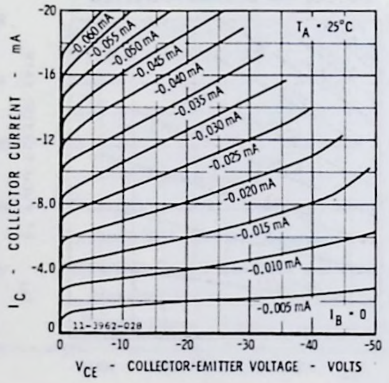
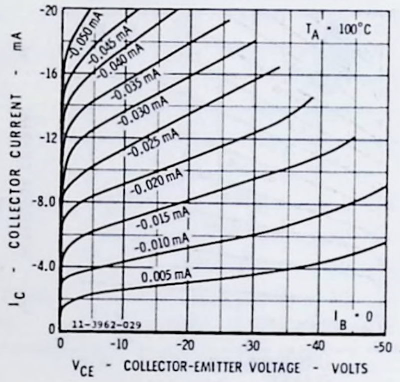
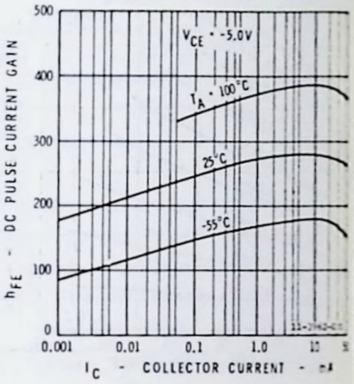


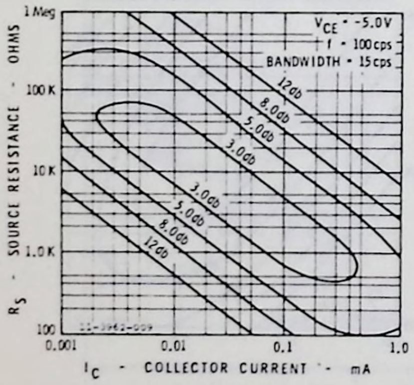
COLLECTOR CHARACTERISTICS*



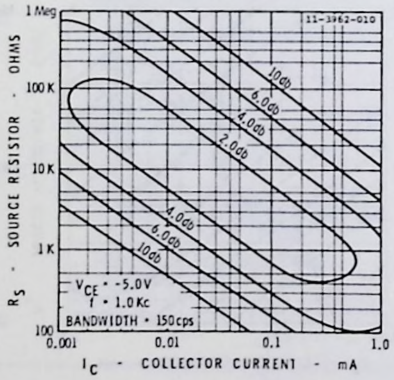
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



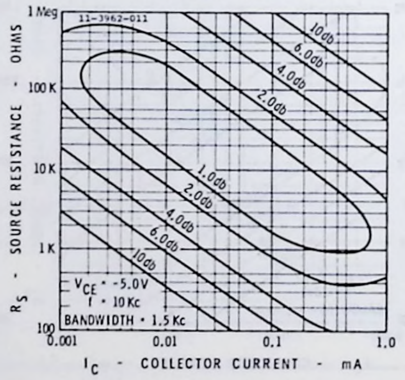
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



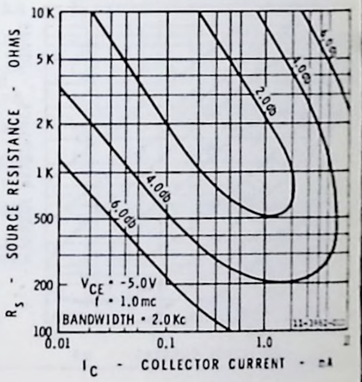
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



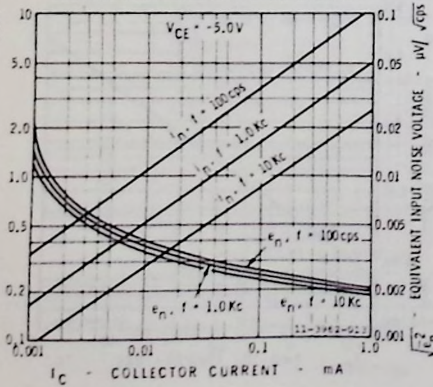
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



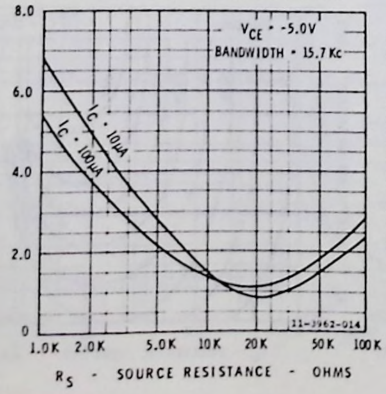
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



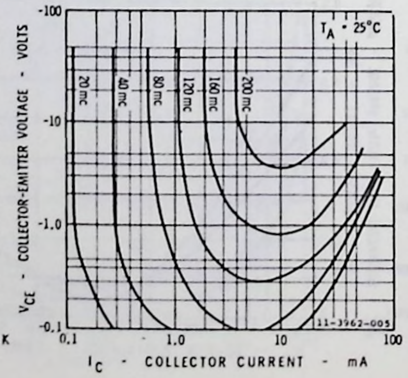
EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT VERSUS COLLECTOR CURRENT



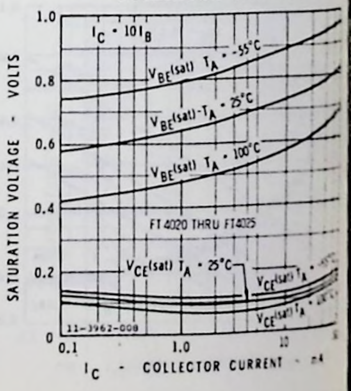
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



COLLECTOR AND BASE SATURATION VOLTAGES VERSUS COLLECTOR CURRENT



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* Single family characteristics on Transistor Curve Tracer.

2N4955 · 2N4956

NPN LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

ETA MATCH -- 20% MAX. AT 100 μA.

$_{BE}$ TRACKING -- 20 μV/°C MAX. AT 100 μA FROM −40°C TO +85°C.

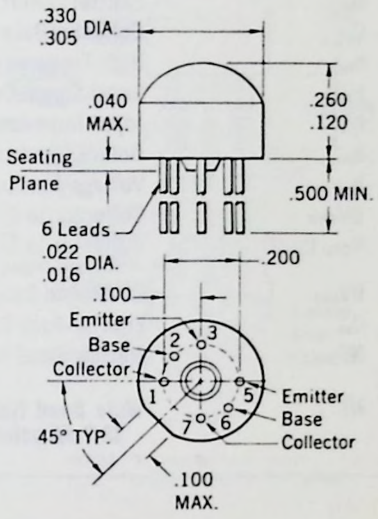
$_{BE}$ MATCH -- 5.0 mV MAX. AT 100 μA.

$_{FE}$ -- 100 MIN. AT 100 μA; 60 MIN. AT 10 μA.

OW NOISE FIGURE -- 4.5 dB MAX.

OLID PACKAGE TO GIVE MAXIMUM MECHANICAL SUPPORT TO THE CHIP.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Package weight is 0.77 gram
Package is electrically
non conductive material

OLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 seconds Time Limit)	+260°C

Maximum Power Dissipation [Note 2 and 3]

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	0.75 Watt	1.3 Watts
at 25°C Ambient Temperature	0.35 Watt	0.45 Watt

Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	25 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	30 mA

CHING AND ELECTRICAL CHARACTERISTICS FOR 2N4956 (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	For 2N4956 only MIN.	For 2N4956 only MAX.	UNITS	TEST CONDITIONS	
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio [Note 5]**	**0.8**	**1.0**		$I_C = 100\ \mu A$	$V_{CE} = 5.0\ V$
$(V_{BE1} - V_{BE2})$	Base-Emitter Voltage Differential [Note 6]		10	mV	$I_C = 10\ \mu A$ to $1.0\ mA$	$V_{CE} = 5.0\ V$
$(V_{BE1} - V_{BE2})$	**Base-Emitter Voltage Differential [Note 6]**		**5.0**	**mV**	$I_C = 100\ \mu A$	$V_{CE} = 5.0\ V$
$\Delta(V_{BE1} - V_{BE2})$	**Base-Emitter Voltage Differential Change ($T_A = -40°C$ to $+25°C$) [Note 6]**		**1.3 (20 μV/°C)**	**mV**	$I_C = 100\ \mu A$	$V_{CE} = 5.0\ V$
$\Delta(V_{BE1} - V_{BE2})$	**Base-Emitter Voltage Differential Change ($T_A = +25°C$ to $+85°C$) [Note 6]**		**1.2 (20 μV/°C)**	**mV**	$I_C = 100\ \mu A$	$V_{CE} = 5.0\ V$

* Planar is a patented Fairchild process.

ES:

hese ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

hese are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

hese ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 133°C/Watt (derating factor of 7.5 mW/°C) for one side; and 77°C/Watt (derating actor of 13 mW/°C) for both sides. Junction to ambient thermal resistance of 286°C/Watt (derating factor of 3.5 mW/°C) for one side; and 222°C/Watt (derating factor of 4.5 mW/°C) for oth sides.

ating refers to a high-current point where collector-to-emitter voltage is lowest.

owest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.

bsolute values.

ulse Conditions: length = 300 μs; duty cycle = 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

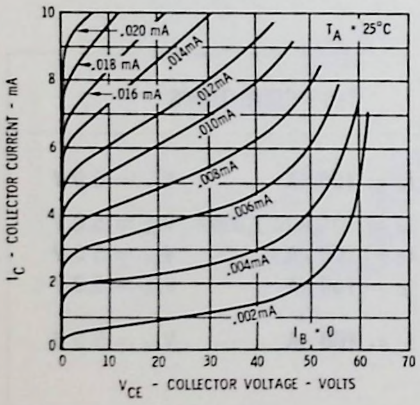
FAIRCHILD TRANSISTORS 2N4955 • 2N4956

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

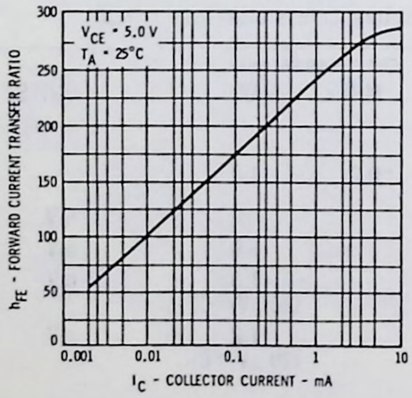
SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	150			$I_C = 1.0$ mA	$V_{CE} = 5.0$
h_{FE}	**DC Current Gain**	**100**			**$I_C = 100\ \mu A$**	$V_{CE} = 5.0$
h_{FE}	**DC Current Gain**	**60**	**600**		**$I_C = 10\ \mu A$**	$V_{CE} = 5.0$
V_{CE} (sat)	Collector Saturation Voltage		0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$
V_{BE} (on)	Emitter-Base On Voltage		0.7	Volts	$I_C = 0.1$ mA	$V_{CE} = 5.0$
I_{CBO}	Collector Cutoff Current		10	nA	$I_E = 0$	$V_{CB} = 25$
I_{CBO} (85°C)	Collector Cutoff Current		1.0	µA	$I_E = 0$	$V_{CB} = 25$
I_{CEO}	Collector Cutoff Current		10	nA	$I_B = 0$	$V_{CE} = 5.0$
I_{EBO}	Emitter Cutoff Current		10	nA	$I_C = 0$	$V_{EB} = 5.0$
C_{cb}	Collector-Base Capacitance		6.0	pF	$I_E = 0$	$V_{CB} = 10$
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0	15		$I_C = 1.0$ mA	$V_{CE} = 5.0$
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	150	1000		$I_C = 1.0$ mA	$V_{CE} = 5.0$
h_{ie}	Input Impedance (f = 1.0 kHz)	3.5	30	kohms	$I_C = 1.0$ mA	$V_{CE} = 5.0$
h_{oe}	Output Conductance (f = 1.0 kHz)		40	µmhos	$I_C = 1.0$ mA	$V_{CE} = 5.0$
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)		800	$X10^{-6}$	$I_C = 1.0$ mA	$V_{CE} = 5.0$
BV_{CBO}	Collector to Base Breakdown Voltage	30		Volts	$I_C = 10\ \mu A$	$I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (pulsed, notes 4 and 7)	25		Volts	$I_C = 2.0$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	$I_E = 10\ \mu A$	$I_C = 0$
C_{eb}	Emitter-Base Capacitance		6.0	pF	$I_C = 0$	$V_{EB} = 0.5$
NF	Narrow Band Noise Figure (f = 1.0 kHz)		4.5	dB	$I_C = 10\ \mu A$ B.W. = 200 Hz	$V_{CE} = 5.0$ $R_S = 10$
NF	**Wide Band Noise Figure (3.0 dB points @ 10 Hz and 10 kHz)**		**4.5**	**dB**	**$I_C = 10\ \mu A$ B.W. = 15.7 kHz**	$V_{CE} = 5.0$ $R_S = 10$

TYPICAL ELECTRICAL CHARACTERISTICS

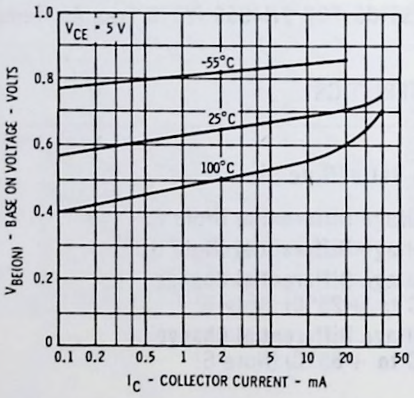
COLLECTOR CHARACTERISTICS*



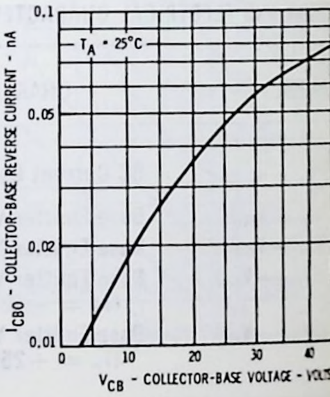
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



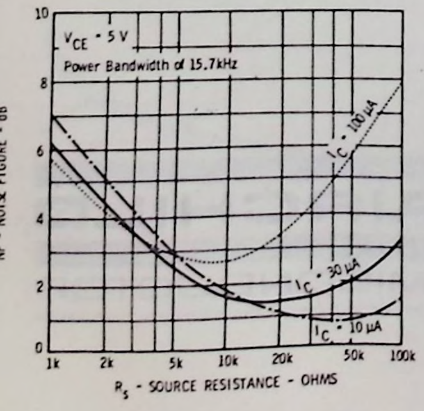
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



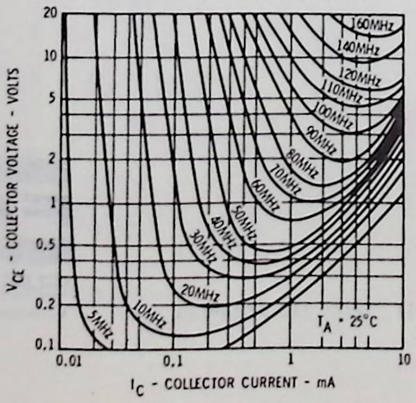
COLLECTOR-BASE DIODE REVE CURRENT VERSUS REVERSE BIAS VOLTAGE



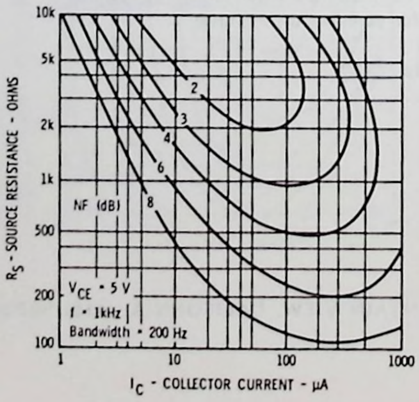
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



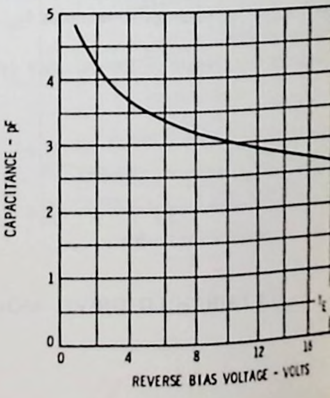
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTA



2N5254 • 2N5255 • 2N5256

PNP LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **EXCELLENT V_{BE} MATCH . . . . . 3.0 mV (MAX.) AT 100 μA**
- **TIGHT BETA MATCH . . . . . . 10% (MAX.) AT 100 μA**
- **EXCELLENT V_{BE} TRACKING . . . 10 μV/°C (MAX.) AT 100 μA FROM −40°C TO +85°C**
- **HIGH BETA . . . . 175 (MIN.) AT 1.0 mA; 150 (MIN.) AT 100μA**
- **LOW NOISE FIGURE . . . . . . 2.5 dB (MAX.) AT 1.0 kHz**
- **LOW COST EPOXY PACKAGE**

SOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

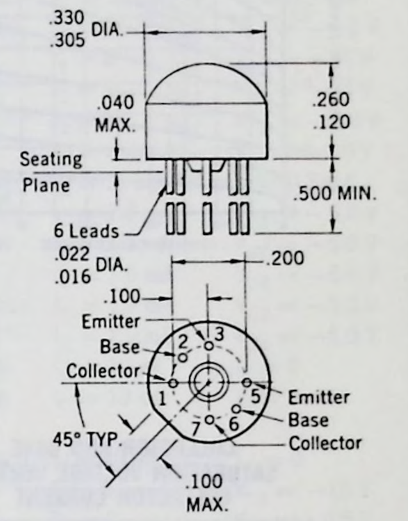
Maximum Power Dissipation (Notes 2 and 3)

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	0.8 Watt	1.4 Watts
at 25°C Ambient Temperature	0.35 Watt	0.43 Watt

Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	−40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts
I_C	Collector Current	50 mA

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Package weight is 0.77 gram

MATCHING AND ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5255 MIN.	2N5255 TYP.	2N5255 MAX.	2N5256 MIN.	2N5256 TYP.	2N5256 MAX.	UNITS	TEST CONDITIONS	
h_{FE1}/h_{FE2}	**DC Current Gain Ratio** (Note 5)	0.8		1.0	**0.9**		**1.0**		$I_C = 100\ \mu A$	$V_{CE} = -5.0\ V$
$\lvert(V_{BE1} - V_{BE2})\rvert$	**Base-Emitter Voltage Differential** (Note 6)			5.0			**3.0**	mV	$I_C = 100\ \mu A$	$V_{CE} = -5.0\ V$
$\lvert\Delta(V_{BE1} - V_{BE2})\rvert$	**Base-Emitter Voltage Differential Change** **($T_A = -40°C$ to $+25°C$)** (Note 6)			1.3 (20 μV/°C)			**0.65** **(10 μV/°C)**	mV	$I_C = 100\ \mu A$	$V_{CE} = -5.0\ V$
$\lvert\Delta(V_{BE1} - V_{BE2})\rvert$	Base-Emitter Voltage Differential Change ($T_A = +25°C$ to $+85°C$) (Note 6)			1.2 (20 μV/°C)			0.60 (10 μV/°C)	mV	$I_C = 100\ \mu A$	$V_{CE} = -5.0\ V$
$I_{B1} - I_{B2}$	Base Current Differential		80			40		nA	$I_C = 100\ \mu A$	$V_{CE} = -5.0\ V$
$\Delta(I_{B1} - I_{B2})$	Base Current Differential Change ($T_A = -40°C$ to $+85°C$)		2.5			2.0		nA/°C	$I_C = 100\ \mu A$	$V_{CE} = -5.0\ V$

dditional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process.

OTES:

1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C) for one side, and 71°C/Watt (derating factor of 14 mW/°C) for both sides. Junction to ambient thermal resistance of 285°C/Watt (derating factor of 3.5 mW/°C) for one side; and 233°C/Watt (derating factor of 4.3 mW/°C) for both sides.
4) Rating refers to a high-current point where collector to emitter voltage is lowest.
5) Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.
6) Absolute values.
7) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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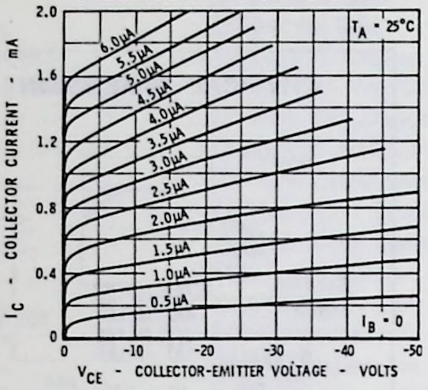
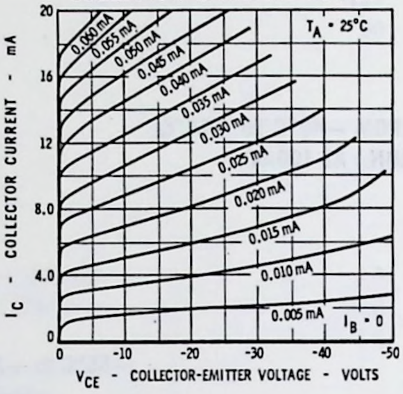
TYPICAL ELECTRICAL CHARACTERISTICS

2N5254 ONLY

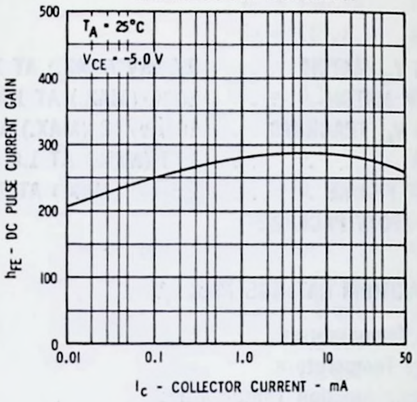
COLLECTOR CHARACTERISTICS*



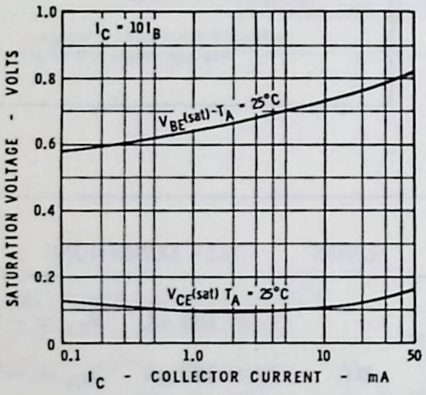
COLLECTOR CHARACTERISTICS*



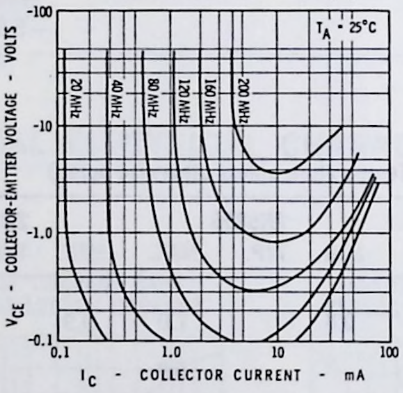
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



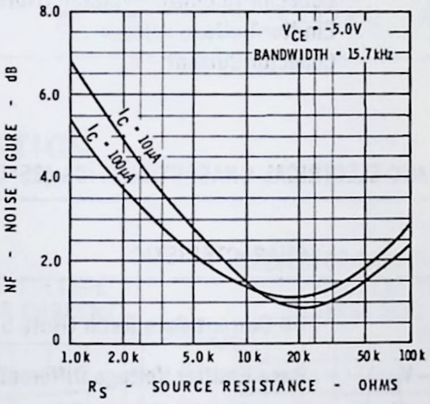
COLLECTOR AND BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



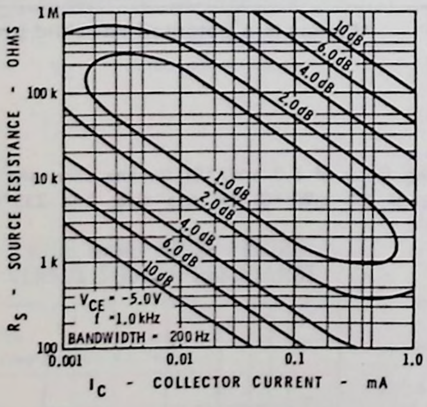
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



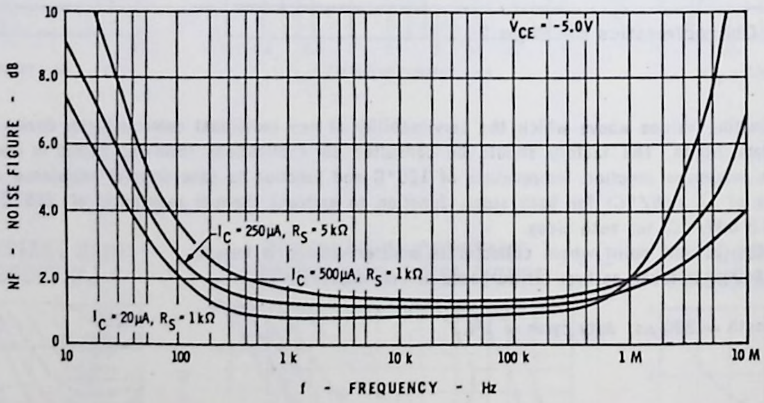
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



NOISE FIGURE VERSUS FREQUENCY



*Single family characteristics on Transistor Curve Tracer

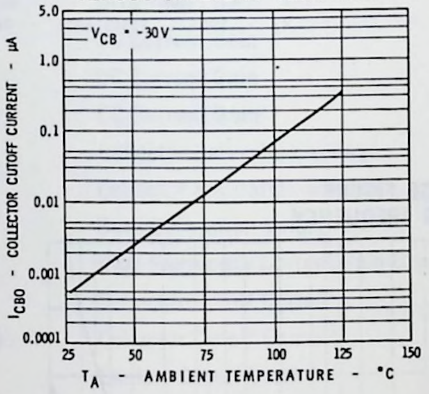
FAIRCHILD TRANSISTORS 2N5254 • 2N5255 • 2N5256

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

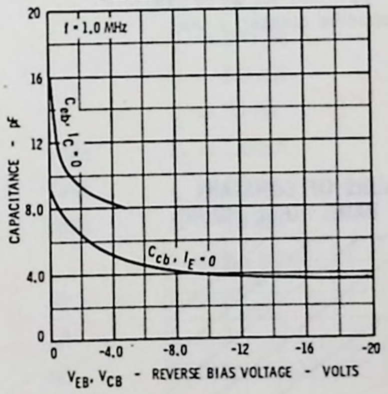
SYMBOL	CHARACTERISTIC	2N5254 MIN.	2N5254 MAX.	2N5255 2N5256 MIN.	2N5255 2N5256 MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	70		**175**			**$I_C = 1.0$ m**	**E = −5.0 V**
h_{FE}	**DC Current Gain**	50	750	**150**	750		**$I_C = 100$**	**= −5.0 V**
h_{FE}	DC Current Gain			90			$I_C = 20$ µ	= −5.0 V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 7)		−0.25		−0.25	Volts	$I_C = 10$	0.5 mA
$V_{BE(on)}$	Emitter-Base On Voltage		−0.9		−0.9	Volts	$I_C = 0.1$	= −5.0 V
I_{CBO}	Collector Cutoff Current		10		10	nA	$I_E = 0$	V
I_{CBO}(85°C)	Collector Cutoff Current		1.0		1.0	µA	$I_E = 0$	
I_{CEO}	Collector Cutoff Current		10		10	nA	$I_B = 0$	
I_{EBO}	Emitter Cutoff Current		10		10	nA	$I_C = 0$	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 7)		−0.9		−0.9	Volts	$I_C = 10$	A
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0	15	2.0	15		$I_C = 1.0$	= −5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	70	900	175	900		$I_C = 1.0$	= −5.0 V
h_{ie}	Input Impedance (f = 1.0 kHz)	1.7	25	4.4	25	kΩ	$I_C = 1.0$	= −5.0 V
h_{oe}	Output Conductance (f = 1.0 kHz)	5.0	70	15	70	µmhos	$I_C = 1.0$	E = −5.0 V
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)		1200		1200	X10^{-6}	$I_C = 1.0$ m	CE = −5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	−40		−40		Volts	$I_C = 10$ µA	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (pulsed, Notes 4 and 7)	−40		−40		Volts	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		−5.0		Volts	$I_E = 10$ µA	$I_C = 0$
C_{cb}	Collector to Base Capacitance		6.0		6.0	pF	$I_E = 0$	$V_{CB} = -10$ V
C_{eb}	Emitter to Base Capacitance		16		16	pF	$I_C = 0$	$V_{EB} = -0.5$ V
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**		3.0		**2.5**	**dB**	**$I_C = 100$ µA B.W. = 200 Hz**	**$V_{CE} = -5.0$ V $R_S = 10$ kΩ**
NF	Wide Band Noise Figure (3.0 dB points at 10 Hz and 10 kHz)		3.0		2.5	dB	$I_C = 100$ µA B.W. = 15.7 kHz	$V_{CE} = -5.0$ V $R_S = 10$ kΩ

THESE CURVES APPLY TO ALL TYPES

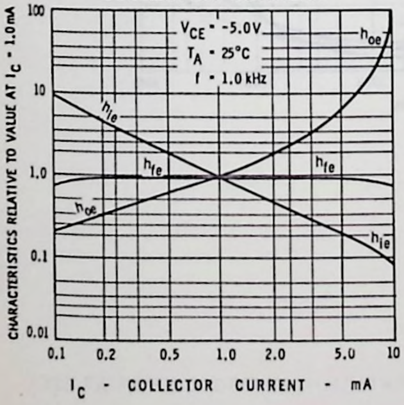
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



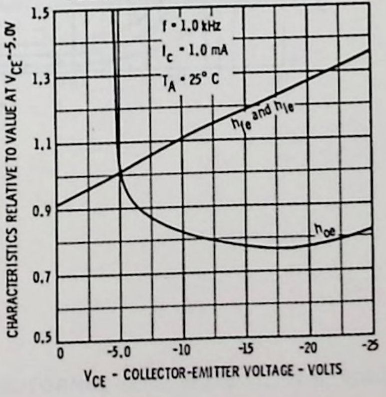
CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



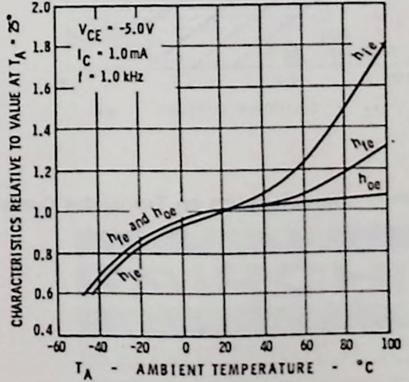
COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT



COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR-EMITTER VOLTAGE



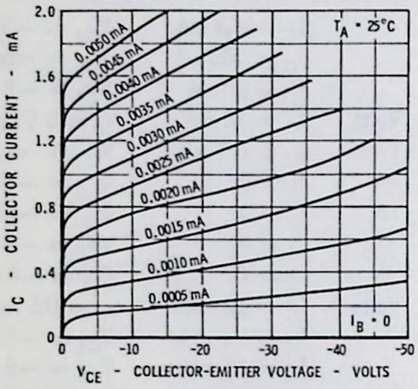
COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE



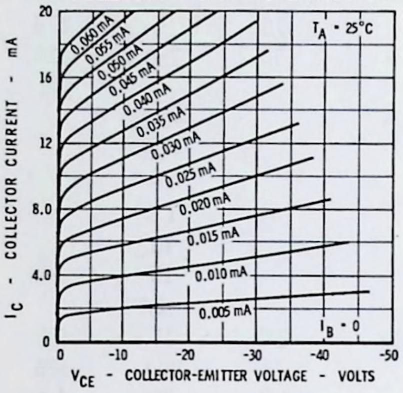
TYPICAL ELECTRICAL CHARACTERISTICS

2N5255 • 2N5256

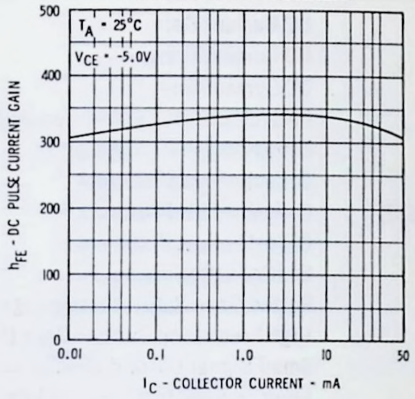
COLLECTOR CHARACTERISTICS*



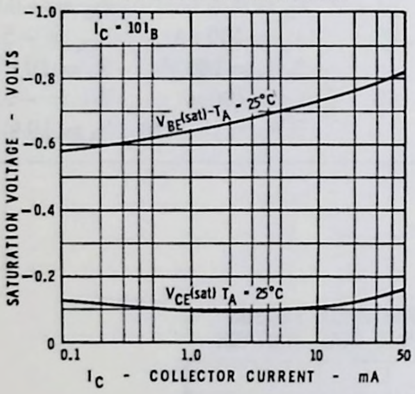
COLLECTOR CHARACTERISTICS*



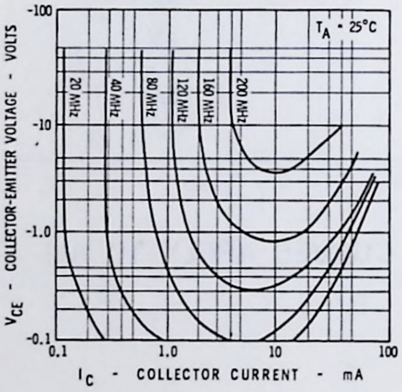
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



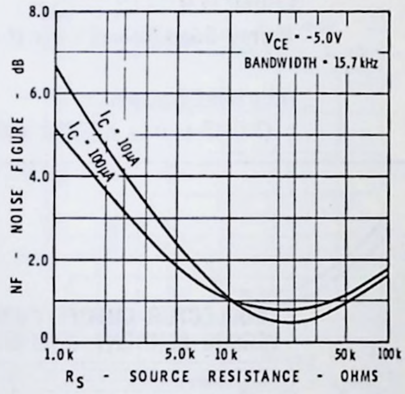
COLLECTOR AND BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



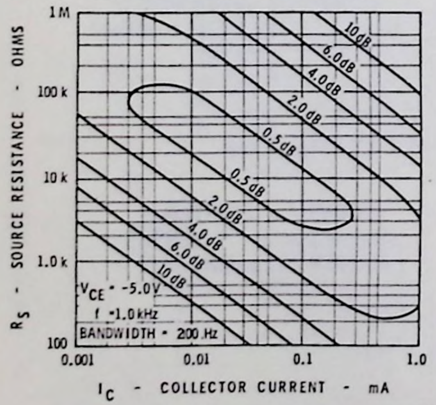
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



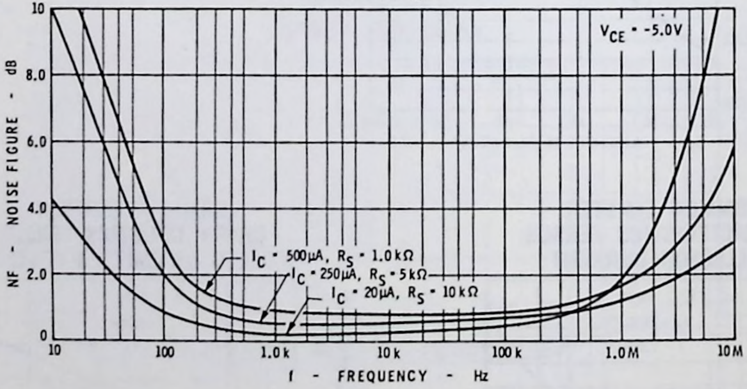
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



NOISE FIGURE VERSUS FREQUENCY



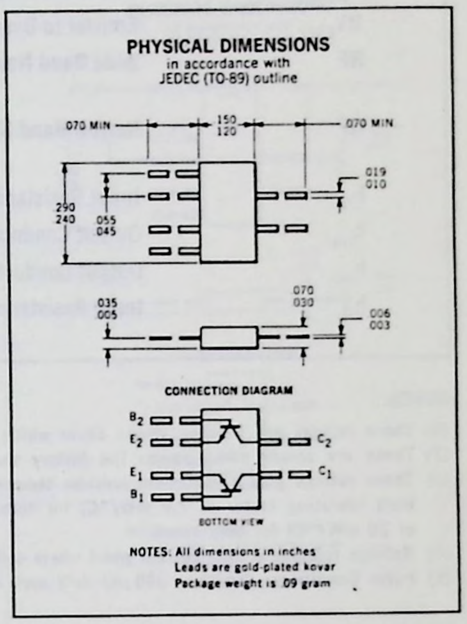
*Single family characteristics on Transistor Curve Tracer

SP10800

NPN LOW-LEVEL, LOW-NOISE DUAL TRANSISTOR

DIFFUSED SILICON PLANAR* TRANSISTOR

TWO DEVICES IN 0.125 X 0.250 INCHES FOR HIGH DENSITY PACKAGING
HIGH GAIN . . . . h_{FE} = 60-600 AT 10 μA
. . . . h_{FE} = 100 (MIN) AT 100 μA
BREAKDOWN VOLTAGE . . . LV_{CEO} = 45 V (MIN)
LOW NOISE . . . . NF = 4.0 dB (MAX) - 1 kHz AND WIDE BAND



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package weight is .09 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 second time limit)	+300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)	**One Side**	**Both Sides**
Total Dissipation at 25°C Case Temperature	1.75 Watts	3.5 Watts
at 25°C Ambient Temperature	0.25 Watt	0.350 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	60	600		$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	**DC Current Gain**	100			$I_C = 100\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	**DC Current Gain**	150			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Current Gain	15			$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
$V_{CE}(sat)$	Collector Saturation Voltage		0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
$V_{CE}(sat)$	Collector Saturation Voltage		1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
$V_{BE}(sat)$	Base Saturation Voltage		1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
h_{fe}	High Frequency Current Gain (f = 30 MHz)	2.0			$I_C = 0.5$ mA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Cutoff Current		10	nA	$I_E = 0$	$V_{CB} = 45$ V
$I_{CBO}(150°C)$	Collector Cutoff Current		10	μA	$I_E = 0$	$V_{CB} = 45$ V
I_{EBO}	Emitter Cutoff Current		10	nA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEO}	Collector-Emitter Cutoff Current		10	nA	$I_B = 0$	$V_{CE} = 5.0$ V

*Planar is a patented Fairchild process.

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FAIRCHILD TRANSISTOR SP10800

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
C_{obo}	Output Capacitance		6.0	pF	$I_E = 0$	$V_{CB} = 5.0\,V$
C_{ibo}	Input Capacitance		6.0	pF	$I_C = 0$	$V_{EB} = 0.5\,V$
BV_{CBO}	Collector to Base Breakdown Voltage	45		Volts	$I_C = 10\,\mu A$	$I_E = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	**45**		**Volts**	**$I_C = 10\,mA$**	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		Volts	$I_C = 0$	$I_E = 10\,\mu A$
NF	**Wide Band Noise Figure (f = 15.7 kHz)**		**4.0**	**dB**	**$I_C = 10\,\mu A$**	**$V_{CE} = 5.0\,V$** **$R_S = 10k\Omega$**
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**		**4.0**	**dB**	**$I_C = 10\,\mu A$** **PBW = 200 Hz**	**$V_{CE} = 5.0\,V$** **$R_S = 10k\Omega$**
h_{ie}	Input Resistance (f = 1 kHz)	3.5		kΩ	$I_C = 1.0\,mA$	$V_{CE} = 5.0\,V$
h_{oe}	Output Conductance (f = 1 kHz)	5.0	30	μmho	$I_C = 1.0\,mA$	$V_{CE} = 5.0\,V$
h_{ob}	Output Conductance (f = 1 kHz)		1.0	μmho	$I_C = 1.0\,mA$	$V_{CB} = 5.0\,V$
h_{ib}	Input Resistance (f = 1 kHz)	25	32	Ω	$I_C = 1.0\,mA$	$V_{CB} = 5.0\,V$

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 700°C/Watt (derating factor of 1.42 mW/°C) for one side; 500°C Watt (derating factor of 2.0 mW/°C) for both sides. Junction to case thermal resistance of 100°C/Watt (derating factor of 10 mW/°C) for one side; 50°C/Watt (derating fac of 20 mW/°C) for both sides.
(4) Ratings refer to a high-current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

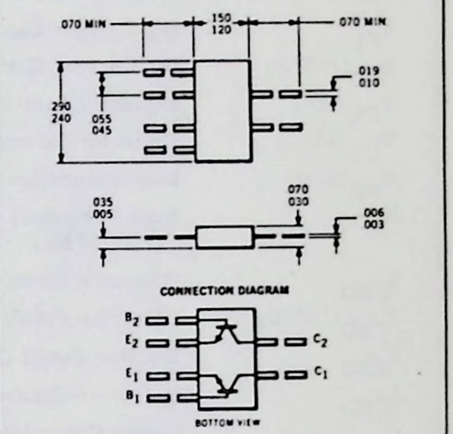
SP10801

NPN LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIER

DIFFUSED SILICON PLANAR TRANSISTOR

GENERAL DESCRIPTION - The six-terminal device contains two isolated High-Gain, Low-Noise NPN Double-Diffused Silicon Planar Transistors in one hermetically sealed enclosure. It is designed for use in high-performance amplifier and differential-amplifier circuits requiring high-gain and low-noise at low-current levels. The SP 10801 features very high beta at low-collector current.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-89) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Package weight is .09 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	+300°C Maximum

Maximum Power Dissipation (Notes 2 and 3)	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	1.75 Watts	3.5 Watts
at 25°C Ambient Temperature	0.25 Watt	0.350 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	45 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts

ATCHING and ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
$\frac{h_{FE\,1}}{h_{FE\,2}}$	DC Current Gain Ratio (Note 6)	0.8	1.0		I_C = 100 μA V_{CE} = 5.0 V
$\lvert V_{BE\,1} - V_{BE\,2} \rvert$	Base-Emitter Voltage Differential		5.0	mV	I_C = 100 μA V_{CE} = 5.0 V
$\lvert V_{BE\,1} - V_{BE\,2} \rvert$	Base-Emitter Voltage Differential		10	mV	I_C = 10 μA V_{CE} = 5.0 V
$\lvert V_{BE\,1} - V_{BE\,2} \rvert$	Base-Emitter Voltage Differential		10	mV	I_C = 1.0 mA V_{CE} = 5.0 V
$\lvert \Delta(V_{BE\,1} - V_{BE\,2}) \rvert$	Base-Emitter Voltage Differential Change (T_A = -55°C to +25°C)		1.6	mV	I_C = 100 μA V_{CE} = 5.0 V
$\lvert \Delta(V_{BE\,1} - V_{BE\,2}) \rvert$	Base-Emitter Voltage Differential Change (T_A = +25°C to +125°C)		2.0	mV	I_C = 100 μA V_{CE} = 5.0 V
NF	Wide Band Noise Figure (Note 8)		4.0	db	I_C = 10 μA V_{CE} = 5.0 V
NF	Narrow Band Noise Figure (Note 7)		4.0	db	I_C = 10 μA V_{CE} = 5.0 V

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ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{FE}	DC Current Gain	60	600		$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	100			$I_C = 100\ \mu A$	$V_{CE} = 5.0$ V
h_{FE}	DC Current Gain	150			$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{FE}(-55°C)	DC Current Gain	15			$I_C = 10\ \mu A$	$V_{CE} = 5.0$ V
V_{CE}(sat)	Collector Saturation Voltage		0.35	Volts	$I_C = 1.0$ mA	$I_B = 0.1$ mA
V_{CE}(sat)	Collector Saturation Voltage		1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
V_{BE}(sat)	Base Saturation Voltage		1.0	Volts	$I_C = 10$ mA	$I_B = 1.0$ mA
h_{fe}	High Frequency Current Gain (f = 30 Mc)	2.0			$I_C = 0.5$ mA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Cutoff Current		10	nA	$I_E = 0$	$V_{CB} = 45$ V
I_{CBO}(150°C)	Collector Cutoff Current		10	µA	$I_E = 0$	$V_{CB} = 45$ V
I_{EBO}	Emitter Cutoff Current		10	nA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEO}	Collector-Emitter Cutoff Current		10	nA	$I_B = 0$	$V_{CE} = 5.0$ V
C_{obo}	Output Capacitance		6.0	pf	$I_E = 0$	$V_{CB} = 5.0$ V
C_{ibo}	Input Capacitance		6.0	pf	$I_C = 0$	$V_{EB} = 0.5$ V
BV_{CBO}	Collector-to-Base Breakdown Voltage	45		Volts	$I_C = 10\ \mu A$	$I_E = 0$
V_{CEO}(sust)	Collector-to-Emitter Sustaining Voltage (Notes 4 and 5)	45		Volts	$I_C = 10$ mA	$I_B = 0$
BV_{EBO}	Emitter-to-Base Breakdown Voltage	6.0		Volts	$I_C = 0$	$I_E = 10\ \mu A$
h_{ie}	Input Resistance (f = 1 Kc)	3.5		KOhm	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance (f = 1 Kc)	5.0	30	µmho	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ob}	Output Conductance (f = 1 Kc)		1.0	µmho	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance (f = 1 Kc)	25	32	Ohm	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-ambient thermal resistance of 700°C/Watt (derating factor of 1.43mW/°C) for one side; 500°C/Watt (derating factor of 2.0 mW/°C) for both sides. Junction-to-case thermal resistance of 100°C/Watt (derating factor of 10 mW/°C) for one side; 50°C/Watt (derating factor of 20 mW/°C) for both sides.

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse conditions: length = 300 µsec; duty cycle = 1%.

(6) Lowest of two h_{FE} readings is taken as $h_{FE\,1}$ for purposes of this ratio.

(7) f = 1 Kc; R_S = 10 KΩ; Power Bandwidth of 200 cps.

(8) f = 10 cps to 10 Kc; R_S = 10 KΩ; Power Bandwidth of 15.7 Kc.

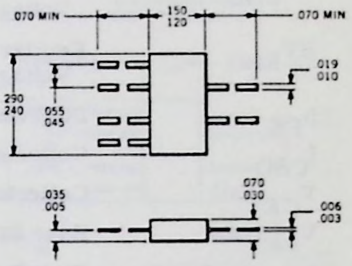
SP10810

PNP DIFFERENTIAL AMPLIFIER

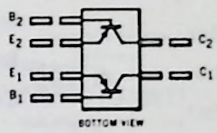
DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION - The SP 10810 is a double diffused silicon PNP Planar epitaxial transistor in the JEDEC TO-89 outline. It is designed as a high-frequency, low noise, differential amplifier.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-89) outline



CONNECTION DIAGRAM



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package weight is .09 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	+300°C Maximum

Maximum Power Dissipation (Notes 2 & 3)	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	1.5 Watts	3.0 Watts
at 25°C Ambient Temperature	0.25 Watt	0.35 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	-20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-15 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts

MATCHING AND ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
$\frac{h_{FE1}}{h_{FE2}}$	DC Current Gain Ratio (Note 6)	0.8	1.0		I_C = 1.0 mA V_{CE} = -5.0 V
$\lvert V_{BE1} - V_{BE2} \rvert$	Base Emitter Voltage Differential		5.0	mV	I_C = 1.0 mA V_{CE} = -5.0 V
$\lvert \Delta(V_{BE1} - V_{BE2}) \rvert$	Base Emitter Voltage Differential Change (T_A = -55°C to +25°C)		4.0	mV	I_C = 1.0 mA V_{CE} = -5.0 V
$\lvert \Delta(V_{BE1} - V_{BE2}) \rvert$	Base Emitter Voltage Differential Change (T_A = +25°C to +125°C)		5.0	mV	I_C = 1.0 mA V_{CE} = -5.0 V

NOTES:

) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 700°C/Watt (derating factor of 1.42 mW/°C) for one side; 500°C/Watt (derating factor of 2.0 mW/°C) for both sides. Junction to case thermal resistance of 110°C/Watt (derating factor of 8.5 mW/°C) for one side; 58°C/Watt (derating factor of 17.2 mW/°C) for both sides.

) Rating refers to a high current point where collector to emitter voltage is lowest.

) Pulse conditions: length = 300 μsec; duty cycle = 1%.

) Lowest of two h_{FE} readings is taken as $h_{FE\,1}$ for purpose of this ratio.

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-15		Volts	I_C = 10 mA I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-20		Volts	I_C = 10 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		Volts	I_C = 0 I_E = 10 μA
h_{FE}	DC Pulse Current Gain (Note 5)	35			I_C = 10 mA V_{CE} = -1.0 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0 V_{CB} = -15 V
V_{CE}(sat)	Collector Saturation Voltage		-0.25	Volt	I_C = 20 mA I_B = 2.0 mA
V_{BE}(sat)	Base Saturation Voltage		-1.0	Volt	I_C = 20 mA I_B = 2.0 mA
h_{fe}	High Frequency Current Gain (f = 100 Mc)	1.0			I_C = 10 mA V_{CE} = -10 V
C_{obo}	Output Capacitance		10	pf	I_E = 0 V_{CB} = -10 V
C_{ibo}	Input Capacitance		10	pf	I_C = 0 V_{BE} = 0.5 V
I_{CBO}(150°C)	Collector Cutoff Current		25	μA	I_E = 0 V_{CB} = -15 V

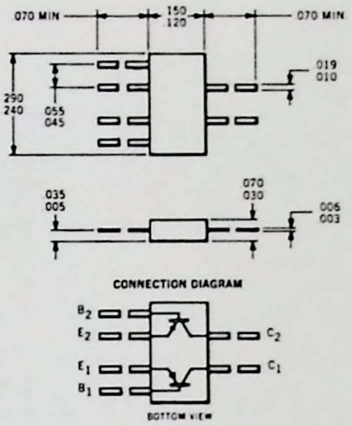
SP10811

DUAL PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

ENERAL DESCRIPTION - The SP 10811 is a double diffused silicon PNP Planar epitaxial dual transistor packaged in the JEDEC TO-89 outline. It is designed as a high-frequency, low noise, general-purpose transistor.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-89) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Package weight is .09 gram

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C	
Operating Junction Temperature	+200°C Maximum	
Lead Temperature (Soldering, 60 sec time limit)	+300°C Maximum	
Maximum Power Dissipation (Notes 2 & 3)	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	1.5 Watts	3.0 Watts
at 25°C Ambient Temperature	0.25 Watt	0.35 Watt

Maximum Voltages

V_{CBO}	Collector to Base Voltage	-20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-15 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts

LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-15		Volts	I_C = 10 mA	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	-20		Volts	I_C = 10 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		Volts	I_C = 0	I_E = 10 μA
$_{FE}$	DC Pulse Current Gain (Note 5)	35			I_C = 10 mA	V_{CE} = -1.0 V
$_{CBO}$	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = -15 V
V_{CE}(sat)	Collector Saturation Voltage		-0.25	Volt	I_C = 20 mA	I_B = 2.0 mA
V_{BE}(sat)	Base Saturation Voltage		-1.0	Volt	I_C = 20 mA	I_B = 2.0 mA
$_{fe}$	High Frequency Current Gain (f = 100 Mc)	1.0			I_C = 10 mA	V_{CE} = -10 V
C_{obo}	Output Capacitance		10	pf	I_E = 0	V_{CB} = -10 V
C_{ibo}	Input Capacitance		10	pf	I_C = 0	V_{BE} = 0.5 V
$_{CBO}$(150°C)	Collector Cutoff Current		25	μA	I_E = 0	V_{CB} = -15 V

OTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 700°C/Watt (derating factor of 1.42 mW/°C) for one side; 500°C/Watt (derating factor of 2.0 mW/°C) for both sides. Junction to case thermal resistance of 110°C/Watt (derating factor of 8.5 mW/°C) for one side; 58°C/Watt (derating factor of 17.2 mW/°C) for both sides.

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length = 300 μsec; duty cycle = 1%.

(6) Lowest of two h_{FE} readings is taken as $h_{FE\,1}$ for purposes of this ratio.

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Electro-Optical Devices

Light Sensors
Light Emitters
Special Photo Products

LIGHT SENSOR SELECTION GUIDE

Product Description	Number of Elements	Spacing Between Elements Inches	Sensitivity μA/mW/cm^2	I_D (max) nA @ 7.0V	FSC Number
Photodiode	1	—	.8	25	FPM200
Phototransistor	1	—	150.0	100	FPM100
Phototransistor	1	—	200.0	100	FPT100
Phototransistor	1	—	40.0	100	2N986
Phototransistor	1	—	100.0	100	2N2452
Photodiode Array*	100	.002	.003	3	FPA201
Photodiode Array*	100	.0025	.005	4	FPA202
Photodiode Array*	63	.004	.010	6	FPA203
Photodiode Array*	42	.006	.025	10	FPA204
Photodiode Array*	126	.006	.025	.20	FPA500
Photodiode Array*	320	.0025	.005	.08	FPA505
Photodiode Array*	250	.002	.003	.06	FPA507
Photodiode Array*	125	.004	.010	.12	FPA509
Phototransistor Array**	64	.005	.100	@ 2V .5/ column	FPA301

**Monolithic arrays of Photodiodes in a single line structure. In all cases, cathode is common. Uniformity of response is ±15%.
***8 x 8 Matrix of Phototransistors with common collectors. Dual Emitters are brought out by row and column to form a Matrix of word rows and bit columns.

LIGHT EMITTER SELECTION GUIDE

Product Description	Number of Elements	Spacing Between Elements Inches	Luminous Current Eff. Lumen/AMP	FSC Number
Light Emitting Diode	1	—	3×10^{-5}	FLB100
Light Emitting Diode	1	—	3×10^{-5}	FLC100
Light Emitting Diode Array	6 - 32	.018	2×10^{-5}	FLA610
Light Emitting Diode Array	6 - 32	.018	2×10^{-5}	FLA611
Light Emitting Diode Array	18 x 32	.018	2×10^{-5}	FLA630

Fairchild Light Emitters are all silicon. The FLA arrays (Monolithic Matrices of light emitting diodes on .018″ centers) are used to annotate data on film. The FLB and FLC devices are discrete light emitters useful because of their switching speed in calibrating photomultiplier tubes. Although very good for their intended purposes, these silicon devices are inefficient as light sources and are not recommended for interface with silicon light sensors unless speed is a prime requirement.

SPECIAL PHOTO PRODUCTS SELECTION GUIDE

Product Description	Function	FSC Number
Light Reflection Transducer (Consists of FPM100 chip and incandescent light bulb; chip detects reflected light)	Edge Sensing	FPA210
Punched Paper Tape Reader (8 FPM100 Phototransistors mounted on .100″ centers)	Reads standard 1.0 inch punched paper tape	FPM7011
Punched Paper Tape Reader (9 FPM100 Phototransistors mounted on .100″ centers)	Reads standard 1.0 inch punched paper tape	FPM7012
Plastic Punched Paper Tape Reader	Reads standard 1.0 inch punched paper tape	FPA700

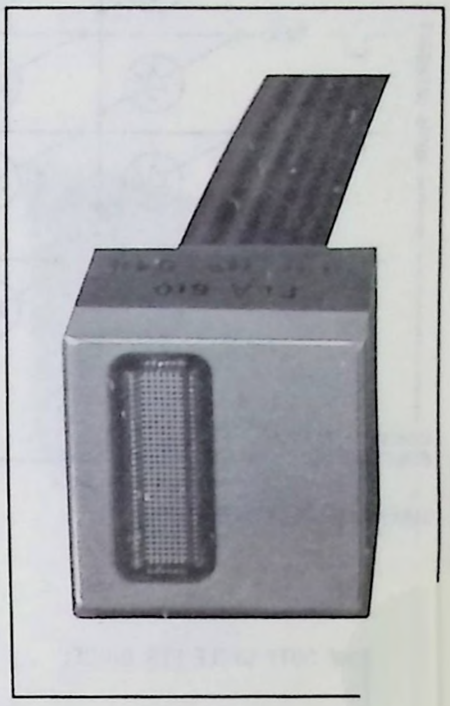
ELECTRO-OPTICAL DEVICE NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
FLA610	7-1	FPA210	7-11	FPM7011	7-30
FLA611	7-3	FPA301	7-13	FPM7012	7-30
FLA630	7-5	FPA500	7-15	FPO100	7-24
FLB100	7-7	FPA505	7-17	FPO200	7-28
FLC100	7-7	FPA507	7-19	FPT100	7-32
FPA201	7-9	FPA509	7-21	2N986	7-34
FPA202	7-9	FPA700	7-22	2N2452	7-34
FPA203	7-9	FPM100	7-24		
FPA204	7-9	FPM200	7-28		

FLA-610

AVALANCHE LUMINESCENT DIODE ARRAY

DIFFUSED SILICON PLANAR* DEVICE



GENERAL DESCRIPTION

The Fairchild Avalanche Luminescent Diode Array, FLA-610, is a data recording device containing 192 light emitting diffused silicon-planar diodes (arranged in a 6-column, 32-row diode matrix). These diodes emit light to produce "dot" patterns on photographic emulsions by "contact printing." Monolithic construction on large area silicon substrates provides precise positioning of the individual diodes which results in efficiently arranged, easily read photographic data block recordings.

GENERAL

Typical current efficiency of visible light output of:	λ $<0.65\ \mu$, approximate 2×10^{11} photons/amp. second 2×10^{-5} lumen/amp. 7×10^{-8} watt/amp.
Uniformity of current efficiency:	±15%
Approximate color temperature:	2500°K

INDIVIDUAL DIODE LIGHT SOURCE CONFIGURATION

Light is emitted from the perimeter of a 0.002" square. The light-emitting line width is approximately 20 microinches. The metalization pattern masks 0.001" of the center of two opposite sides of the diode to leave 0.006" of light-emitting line.

INDIVIDUAL LIGHT-EMITTING ELEMENT

Light emission is obtained by operating the diode in the reverse bias mode. Typical diode operating parameters are:

$$5.8 \leq V_R \leq 12.5 \text{ volts (13.5 V for 611)}$$

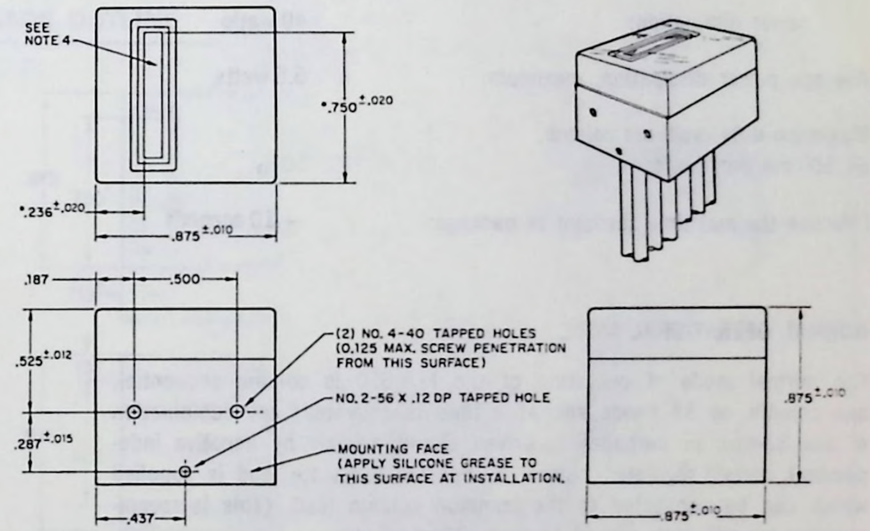
$$0 \leq I_R \leq 100 \text{ mA}$$

where

V_R = voltage between any pair of, each, row and column pins at the connector

I_R = current at any row pin of the connector

PACKAGE OUTLINE


SEE NOTE 4
*.750±.020
*.236±.020
.875±.010
.187
.500
.525±.012
.287±.015
.437
(2) NO. 4-40 TAPPED HOLES (0.125 MAX. SCREW PENETRATION FROM THIS SURFACE)
NO. 2-56 X .12 DP TAPPED HOLE
MOUNTING FACE (APPLY SILICONE GREASE TO THIS SURFACE AT INSTALLATION.
.875±.010
.875±.010

NOTES:

(1) Cable Terminates in Connector: U.S. Components, Inc. #SMI-42 F1-HRSL-DM40 (Mates with #SMI-42 M1-SL-DM40)

(2) Cable length 17" standard length.

(3) Starred dimensions indicate center lines of 1st row and 1st column of the light sources in the matrix array.

(4) Handle film plane surface with **EXTREME CARE** to prevent scratching or puncturing thin mylar film.

*Planar is a patented Fairchild process.

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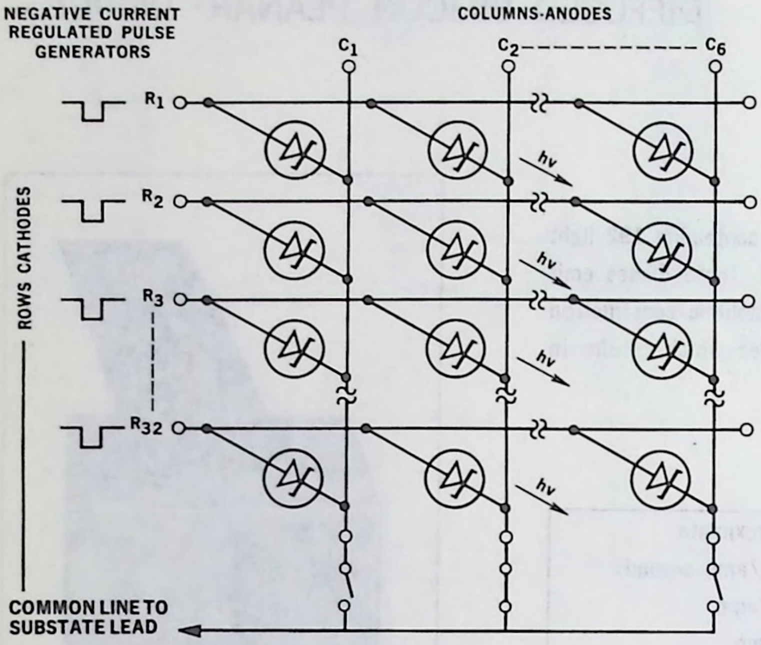
FAIRCHILD DIODE ARRAY FLA-610

TYPICAL COLUMN SEQUENTIAL CIRCUIT


NEGATIVE CURRENT REGULATED PULSE GENERATORS
COLUMNS-ANODES
C1
C2
C6
R1
R2
R3
R32
hv
ROWS CATHODES
COMMON LINE TO SUBSTATE LEAD

MAXIMUM PULSE LENGTH:	160 ms at 25 mA 40 ms at 50 mA 10 ms at 100 mA
MAXIMUM DUTY CYCLE PER DIODE:	50%

DIODE ARRAY

Peak power dissipation:	40 watts
Average power dissipation, maximum:	5.5 watts
Maximum duty cycle per column: @ 100 mA per Diode:	50%
Effective thermal time constant of package:	~ 10 seconds

NORMAL OPERATIONAL MODE

The normal mode of operation of the FLA-610 is column sequential; one column, or 32 anode set, at a time is activated; any combination of the 32-row, or cathodes is driven simultaneously by negative independent current-regulated pulses. A separate substrate lead is supplied which can be connected to the common column lead. (This is recommended for use with current levels > 70mA/diode.)

SPECIAL OPERATIONAL MODES

A large number of operating arrangements may be used. For special applications information should be obtained from Fairchild Semiconductor before installation.

PHYSICAL DESCRIPTION

The array is 6 elements wide by 32 elements long. Electrical connection is made via 6 anode leads and 32 cathode leads. Connections to the silicon chip are arranged to minimize current densities in the device metalization. The package body is electrically isolated (>1.0 megohm at 50 volts) from the array and its connections.

ARRAY

Light emitting diode size:	0.002" x 0.0002"
Center-to-center spacings:	0.018" each way, (6 x 32)
Array size (to corner-device centers):	0.090" x 0.558"

PACKAGE

Dimensions, external:	(See physical dimensions draw
Distance of silicon surface below package face, equivalent optical path in air:	0.004" maximum

MOUNTING

The package is designed for minimum thermal resistance from the a to the side mounting surface. When operating near maximum po rating, mounting support should be kept below 55°C.

For film located within 0.001" of face of FLA-610 and with emul facing same:

Dot shape:	Circular
Dot diameter, nominal:	0.008"
Peak optical density of dot for prescribed conditions:	> 1.3

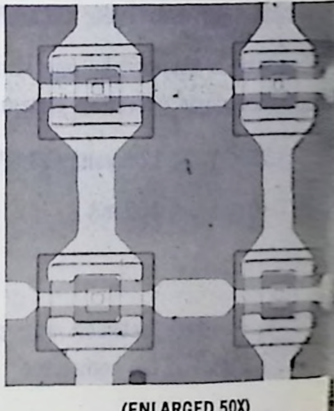
Exposure Index: Daylight-20 (Kodak Panatomic - X, Type 4400)

3 ms pulse at 50 mA

Developed in D 19 at 68°F, for 5 minutes

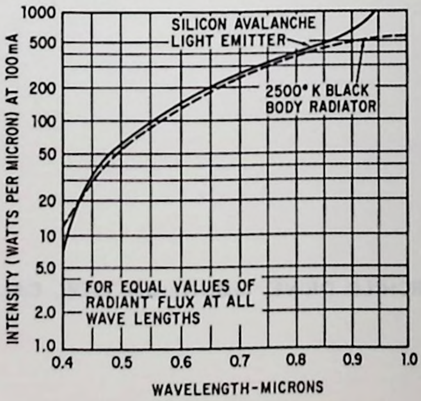
LUMINESCENT DIODE ARRAY CHIP

TYPICAL TEST EXPOSURE



(ENLARGED 50X)

TYPICAL SPECTRAL DISTRIBUTION

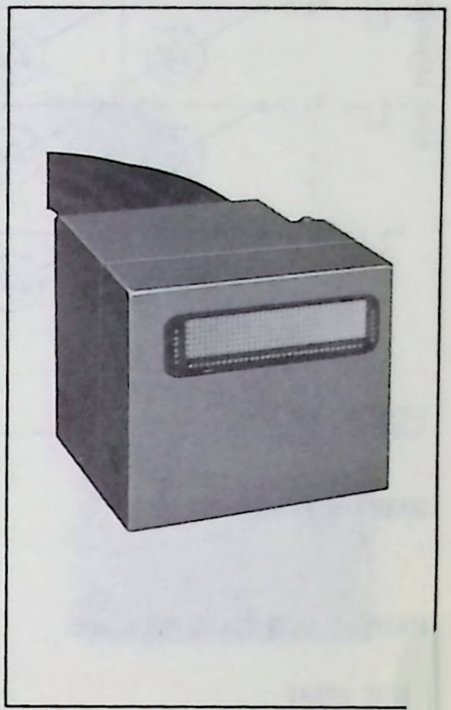


FLA611

AVALANCHE LUMINESCENT DIODE ARRAY

DIFFUSED SILICON PLANAR* DEVICE

NERAL DESCRIPTION — The Fairchild Avalanche Luminescent Diode Array, FLA-611, is a data recording vice containing 192 light emitting diffused silicon-planar diodes (arranged in a 6-column, 32-row diode atrix). These diodes emit light to produce "dot" patterns on photographic emulsions by "contact printing." onolithic construction on large area silicon substrates provide precise positioning of the individual diodes hich results in efficiently arranged, easily read photographic data block recordings.



NERAL

Typical current efficiency of visible light output of:	$\lambda < 0.65\ \mu$, 2×10^{11} photons/amp. sec. 2×10^{-5} lumen/amp. 7×10^{-8} watt/amp.
Uniformity of current efficiency:	± 15%
Approximate color temperature	2500°K

DIVIDUAL DIODE LIGHT SOURCE CONFIGURATION

ght is emitted from the perimeter of a 0.002" square. The light-itting line width is approximately 20 microinches. The metal-ation pattern masks 0.001" of the center of two opposite sides the diode to leave 0.006" of light-emitting line.

DIVIDUAL LIGHT-EMITTING ELEMENT

ht emission is obtained by operating the diode in the reverse s avalanche mode. Typical diode operating parameters are:

$5.8 \leq V_R \leq 12.5$ volts

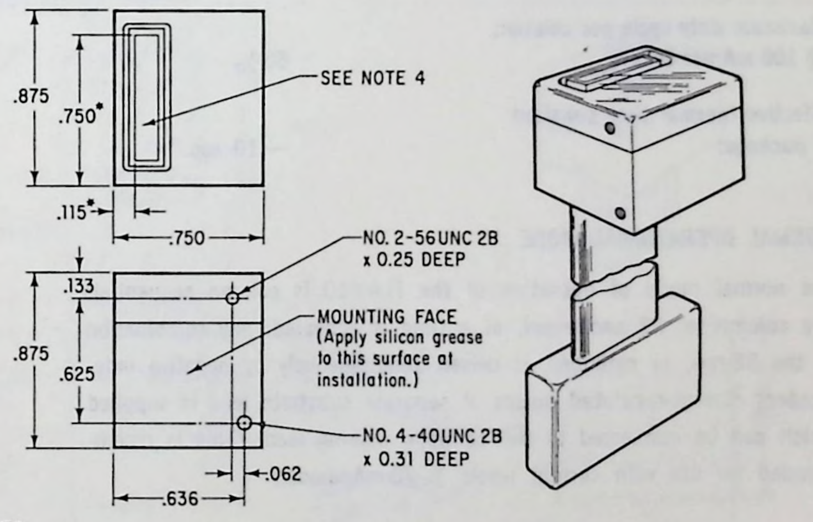
$20 \leq I_R \leq 100$ mA

ere

V_R = voltage between any pair of, each, row and column pins at the connector

I_R = current at any row pin of the connector

PACKAGE OUTLINE



NOTES:

(1) Cable Terminates in Connector: U.S. Components, Inc. #SMI-42 F2-HRSL-DM30

(2) Cable length 17" standard.

(3) Starred dimensions indicate center lines of 1st row and 1st column of the light sources in the matrix array.

(4) Handle film plane surface with **EXTREME CARE** to prevent scratching or puncturing thin mylar film.

*Planar is a patented Fairchild process.

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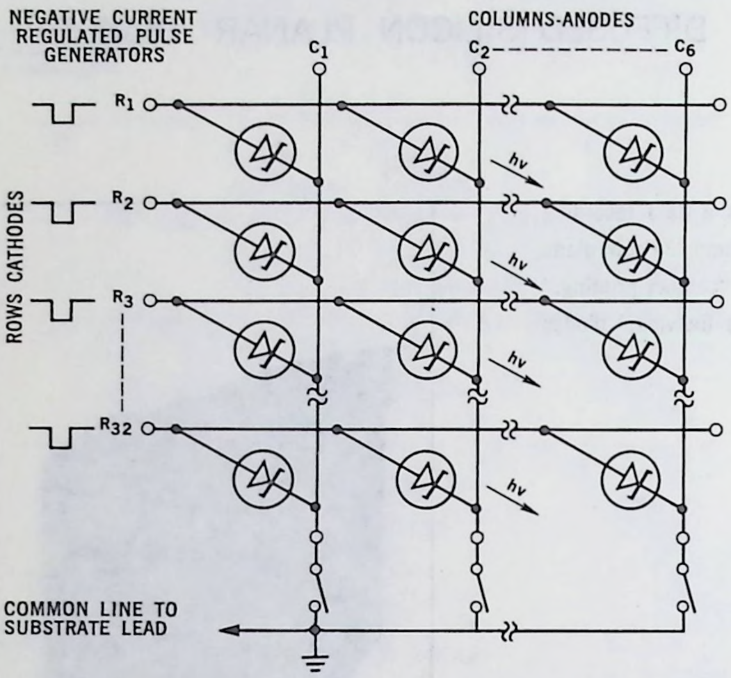
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD DIODE ARRAY FLA611

TYPICAL COLUMN SEQUENTIAL CIRCUIT


NEGATIVE CURRENT REGULATED PULSE GENERATORS
COLUMNS-ANODES
C_1
C_2
C_6
R_1
R_2
R_3
R_{32}
ROWS CATHODES
hν
COMMON LINE TO SUBSTRATE LEAD

MAXIMUM PULSE LENGTH:	160 ms at 25 mA 40 ms at 50 mA 10 ms at 100 mA
MAXIMUM DUTY CYCLE PER DIODE:	50%

DIODE ARRAY

Peak power dissipation:	40 watts
Average power dissipation, maximum:	5.5 watts
Maximum duty cycle per column: @ 100 mA per Diode:	50%
Effective thermal time constant of package:	~ 10 sec.

NORMAL OPERATIONAL MODE

The normal mode of operation of the FLA-610 is column sequential; one column, or 32 anode set, at a time is activated; any combination of the 32-row, or cathodes, is driven simultaneously by negative independent current-regulated pulses. A separate substrate lead is supplied which can be connected to the common column lead. (This is recommended for use with current levels > 70 mA/diode.)

SPECIAL OPERATIONAL MODES

A large number of operating arrangements may be used. For special applications information should be obtained from Fairchild Semiconductor before installation.

PHYSICAL DESCRIPTION

The array is 6 elements wide by 32 elements long. Electrical connection is made via 6 anode leads and 32 cathode leads. Connections to the silicon chip are arranged to minimize current densities in the device metallization. The package body is electrically isolated (> 1.0 megohm at 50 volts) from the array and its connections.

ARRAY

Light emitting diode size:	0.002″ x 0.002″
Center-to-center spacings:	0.018″ each way, (6 x 32)
Array size (to corner-device centers):	0.090″ x 0.558″

PACKAGE

Dimensions, external:	(See physical dimensions dra
Distance of silicon surface below package face, equivalent optical path in air:	0.004″ maximum

MOUNTING

The package is designed for minimum thermal resistance fro array to the side mounting surface. When operating near ma power rating, mounting support should be kept below +55°C.

For film located within 0.001″ of face of the FLA-611 and with e facing same:

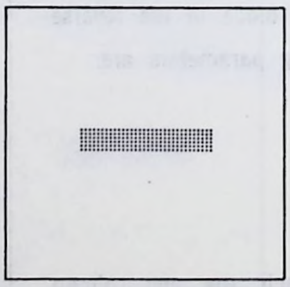
Dot shape:	Circular
Dot diameter, nominal:	0.008″
Peak optical density of dot for prescribed conditions:	> 1.3

Exposure Index: Daylight-20 (Kodak Panatomic - X, Typ

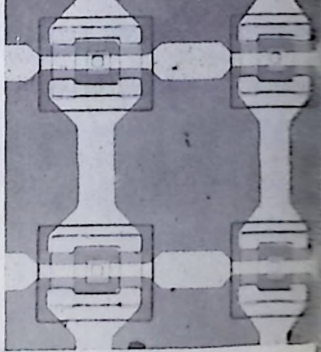
3 ms pulse at 50 mA

Developed in D 19 at +68°F, for 5 min.

TYPICAL TEST EXPOSURE

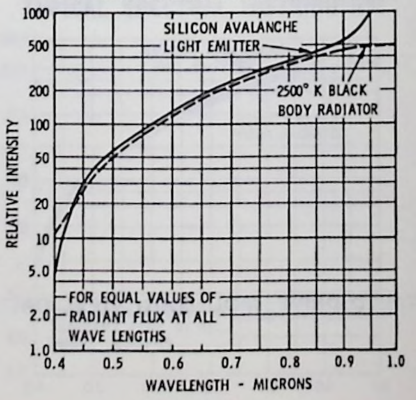


LUMINESCENT DIODE ARRAY C



(ENLARGED 50X)

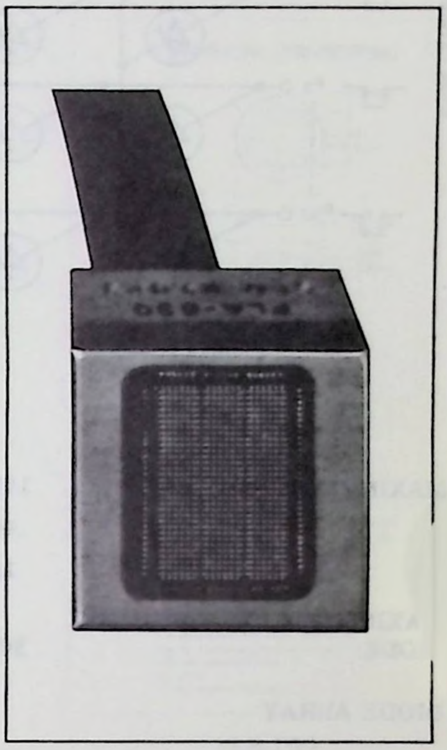
TYPICAL SPECTRAL DISTRIBUTION



FLA-630

AVALANCHE LUMINESCENT DIODE ARRAY

DIFFUSED SILICON PLANAR* DEVICE



ENERAL DESCRIPTION - The Fairchild Avalanche Luminescent Diode Array, FLA-630 is tended primarily as a data recording device containing 576 light-emitting diffused silicon-planar odes (arranged in three adjacent 6-column, 32-row arrays to form an 18 by 32 diode matrix). hese diodes emit light to produce "dot" patterns on photographic emulsions by "contact printing." onolithic construction on large area silicon substrates provides precise positioning of the dividual diodes, which results in efficiently arranged, non-ambiguous easily read photographic ata block recordings.

ENERAL

Typical current efficiency of visible light output of:	λ <0.65 μ, approximate 2×10^{11} photons/amp. second 2×10^{-5} lumen/amp. 7×10^{-8} watt/amp.
Uniformity of current efficiency:	±15%
Approximate color temperature:	2500°K

DIVIDUAL DIODE LIGHT SOURCE CONFIGURATION

ight is emitted from the perimeter of a 0.002" square. The ght-emitting line width is approximately 20 microinches. he metalization pattern masks 0.001" of the center of two pposite sides of the diode to leave 0.006" of light-emitting nes.

DIVIDUAL LIGHT-EMITTING ELEMENT

ight emission is obtained by operating the diode in the everse bias mode. Typical diode operating parameters are:

$$5.8 \leq V_R \leq 13.3 \text{ volts}$$

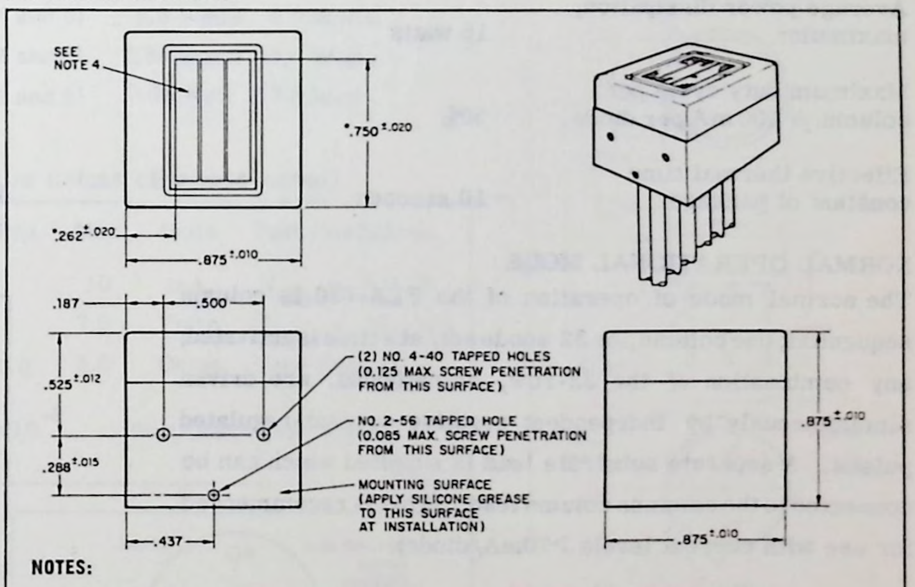
$$0 \leq I_R \leq 100 \text{ mA}$$

here

V_R = voltage between any pair of, each, row and column pins at the connector

I_R = current at any row pin of the connector

PACKAGE OUTLINE


SEE NOTE 4
*.750 ±.020
*.262 ±.020
.875 ±.010
.187
.500
.525 ±.012
.288 ±.015
.437
(2) NO. 4-40 TAPPED HOLES (0.125 MAX. SCREW PENETRATION FROM THIS SURFACE)
NO. 2-56 TAPPED HOLE (0.085 MAX. SCREW PENETRATION FROM THIS SURFACE)
MOUNTING SURFACE (APPLY SILICONE GREASE TO THIS SURFACE AT INSTALLATION)
.875 ±.010
.875 ±.010

NOTES:

1. Cable Terminates in Connector: U. S. Components, Inc., #SMI-50 F2-HRSL-DM40.
2. Cable length 17" standard length.
3. Starred dimensions indicate center lines of 1st row and 1st column of the light sources in the matrix array.
4. Handle film plane surface with **EXTREME CARE** to prevent scratching or puncturing thin mylar film.

* Planar is a patented Fairchild process.

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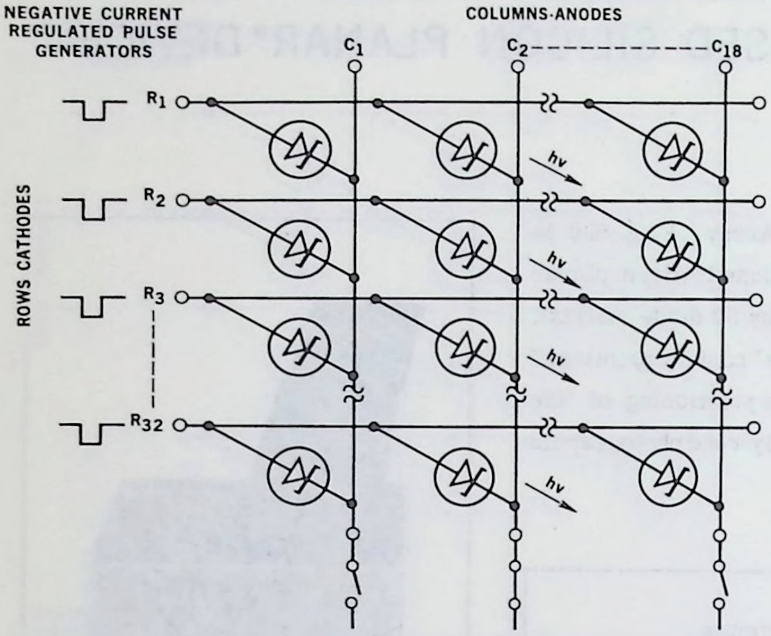
FAIRCHILD DIODE ARRAY FLA-630

TYPICAL COLUMN SEQUENTIAL CIRCUIT



MAXIMUM PULSE LENGTH:	160 ms	at 25 mA
	40 ms	at 50 mA
	10 ms	at 100 mA

MAXIMUM DUTY CYCLE PER DIODE:	50%

DIODE ARRAY

Peak power dissipation:	40 watts
Average power dissipation, maximum:	15 watts
Maximum duty cycle per column: @ 100 mA per diode.	50%
Effective thermal time constant of package:	~ 10 seconds

NORMAL OPERATIONAL MODE

The normal mode of operation of the FLA-630 is column sequential; one column, or 32 anode set, at a time is activated; any combination of the 32-row, or cathodes, are driven simultaneously by independent negative current-regulated pulses. A separate substrate lead is supplied which can be connected to the common column lead. (This is recommended for use with current levels >70mA/diode).

SPECIAL OPERATIONAL MODES

A large number of operating arrangements may be used. For special applications information should be obtained from Fairchild Semiconductor before installation.

PHYSICAL DESCRIPTION

The array is 18 elements wide by 32 elements long. Electrical connection is made via 18 anode leads and 32 cathode leads. Connections to the silicon chip are arranged to minimize current densities in the device metalization. The package body is electrically isolated (>1.0 megohm at 50 volts) from the array and its connections.

ARRAY

Light emitting diode size:	0.002" x 0.002"
Center-to-center spacings:	0.018" each way i blocks of 6 x 32 devi each
Array size (to corner-device centers):	0.344" x 0.558"

PACKAGE

Dimensions, external:	(See physical dimensi drawing)
Distance of silicon surface below package face, equivalent optical path in air:	0.004" maximum

MOUNTING

The package is designed for minimum thermal resista from the array to the side mounting surface. When operat near maximum power rating, mounting support should kept below 55°C.

For film located within 0.001" of face of FLA-630 asse and with emulsion facing same:

Dot shape:	Circular
Dot diameter, nominal:	0.008"
Peak optical density of dot for prescribed conditions:	>1.3

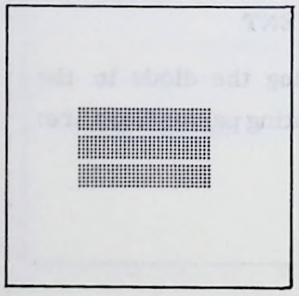
Exposure Index: Daylight-20 (Kodak Panatomic - Type 4400)

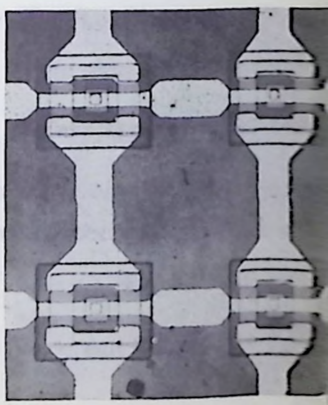
3 msec pulse at 50 mA

Developed in D19 at 68°F for 5 min.

LUMINESCENT DIODE ARRAY CHIP

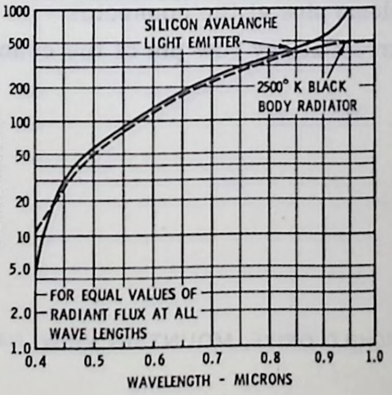
TYPICAL FILM EXPOSURE





(ENLARGED 50X)

TYPICAL SPECTRAL DISTRIBUTION



FLB-100 • FLC-100

AVALANCHE LUMINESCENT DIODES

DIFFUSED SILICON PLANAR* DEVICES

GENERAL DESCRIPTION - The Fairchild Avalanche Luminescent Diode emits visible light from a large geometry diffused silicon P-N junction when operated under continuous or pulsed conditions. Extremely short rise time light pulses can be obtained by driving the diode into avalanche. They provide a simple method of generating light pulses less than 3 nanoseconds turn-on time and turn-off time desirable for calibrating scintillator-photomultiplier assemblies and other photosensitive equipment.

These avalanche luminescent diodes are of great usefulness for the simulation of nuclear event scintillation pulses and other applications where a very fast turn-on/turn-off characteristic is desirable. The nanosecond light pulser together with its linear current efficiency adds ease and accuracy in aligning photomultiplier tubes with respect to signal propagation delay and pulse height calibration as required for scintillation crystal particle detectors used in coincidence circuitry.

ABSOLUTE MAXIMUM RATINGS (Note 3)

Maximum Temperatures			
Storage Temperature		-65°C to +200°C	
Operating Junction Temperature		+200°C Maximum	
Maximum Power Dissipation		FLB-100	FLC-100
Total Dissipation at 25°C Case Temperature	(Notes 4 and 5)	5.0 Watts	6.0 Watts
at 100°C Case Temperature	(Notes 4 and 5)	2.86 Watts	3.4 Watts
at 25°C Ambient Temperature	(Notes 4 and 5)	0.44 Watt	0.9 Watt

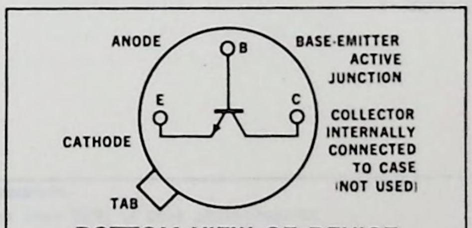
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Conditions
I_R	Reverse Leakage Current			10	mA	V_{EB} = 5.0 V
BV	Avalanche Voltage			7.0	Volts	I_E = 10 mA
Z_z	Incremental Slope of V-I Characteristic in Avalanche Region		2.0	5.0	Ohms	(see Note 1)
	Current Efficiency of Visible Light Output		10×10^{-8}		Watt/Amp	(see Note 2)

NOTES:

(1) 1.0 mA rms, f = 1.0 kHz, superimposed on 50 mA DC.

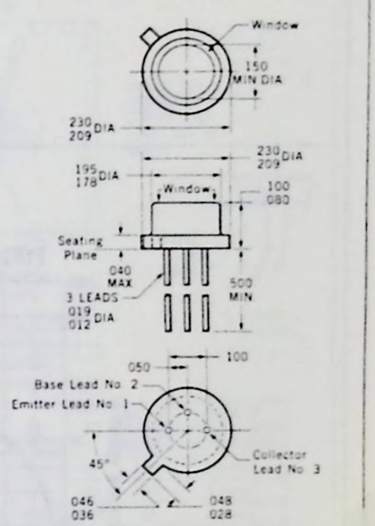
(2) Color Temperature = 2500°K, $\lambda < 0.65\ \mu$.
The light emitting area of the diode measures approximately 0.030" x 0.040".


ANODE
B
BASE-EMITTER ACTIVE JUNCTION
E
C
CATHODE
COLLECTOR INTERNALLY CONNECTED TO CASE (NOT USED)
TAB

BOTTOM VIEW OF DEVICE

* Planar is a patented Fairchild process.

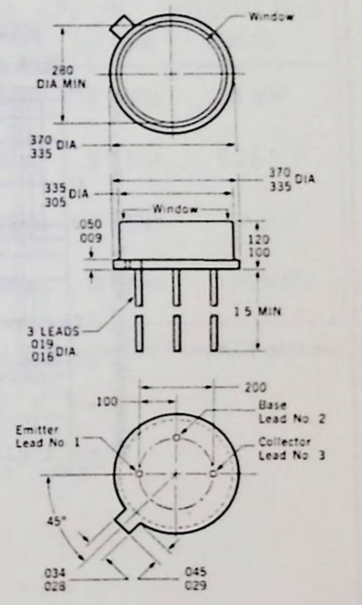
PHYSICAL DIMENSIONS


Window
150 MIN DIA
230/209 DIA
230/209 DIA
195/178 DIA
Window
100/080
Seating Plane
040 MAX
3 LEADS 019/012 DIA
500 MIN
050
100
Base Lead No 2
Emitter Lead No 1
45°
Collector Lead No 3
046/036
048/028

NOTES: All dimensions in inches
Dimensions similar to JEDEC TO 46 except for overall height and semi rigid silicon resin window
Lead No. 3 internally connected to case
Leads are gold plated kovar
See note 6
Package weight is 0.317 gram

FLB-100

PHYSICAL DIMENSIONS


Window
280 DIA MIN
370/335 DIA
370/335 DIA
335/305 DIA
Window
050/009
120/100
1.5 MIN
3 LEADS 019/016 DIA
100
200
Base Lead No 2
Emitter Lead No 1
Collector Lead No 3
45°
034/028
045/029

NOTES: All dimensions in inches
Dimensions similar to JEDEC TO 5 except for overall height and semi rigid silicon resin window
Lead No. 3 internally connected to case
Leads are gold plated kovar
See note 6
Package weight is 1.0 gram

FLC-100

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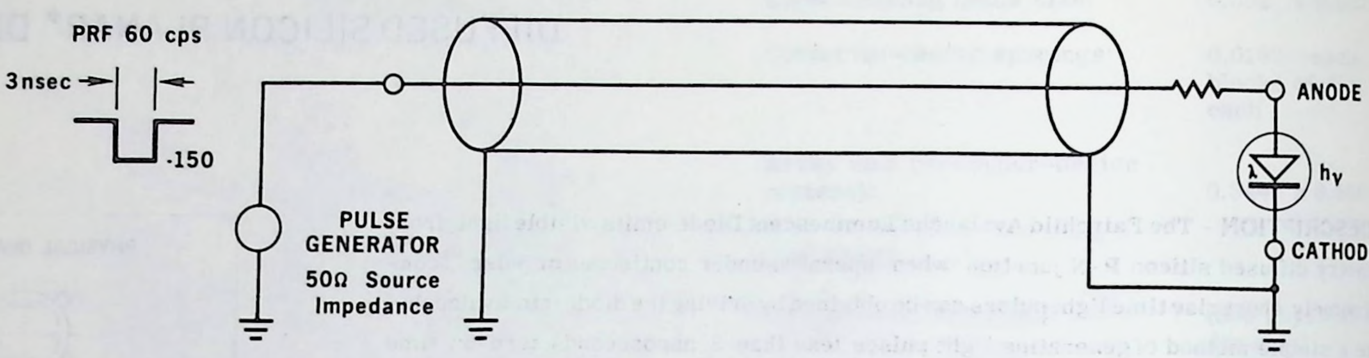
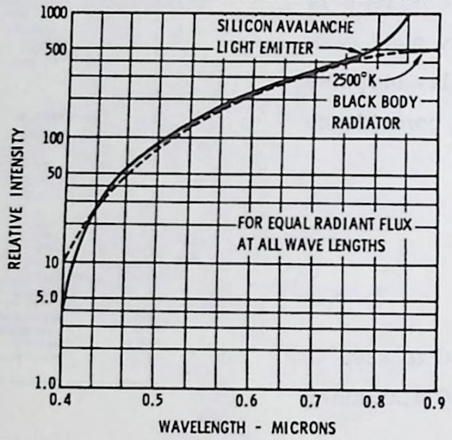
FAIRCHILD AVALANCHE LUMINESCENT DIODES FLB-100 • FLC-100

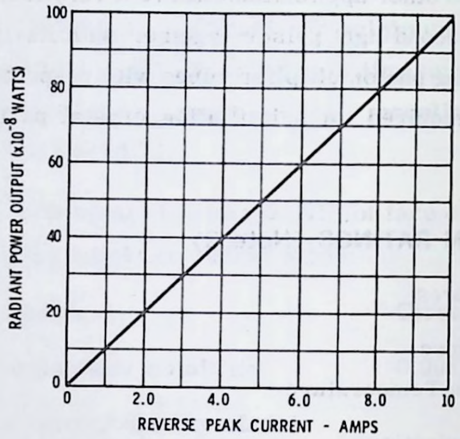
TYPICAL CIRCUIT



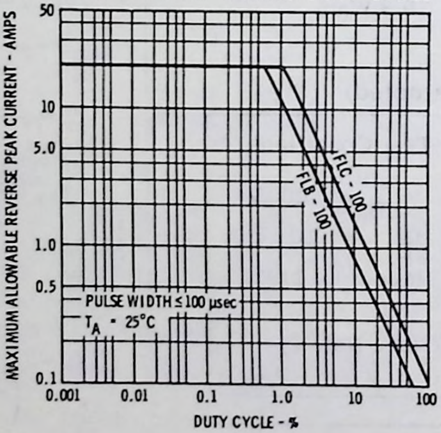
TYPICAL SPECTRAL DISTRIBUTION



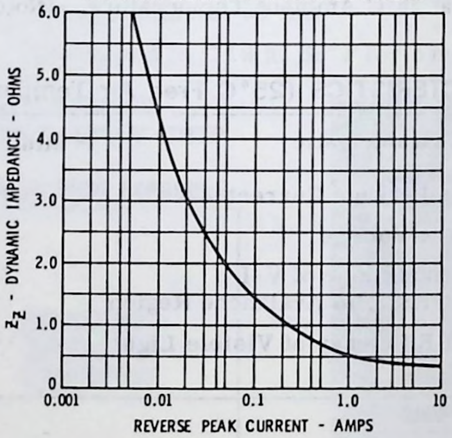
TYPICAL CURRENT EFFICIENCY OF VISIBLE LIGHT OUTPUT



MAXIMUM ALLOWABLE REVERSE PEAK CURRENT VERSUS DUTY CYCLE



TYPICAL DYNAMIC IMPEDANCE VERSUS REVERSE PEAK CURRENT



NOTES:

(3) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(4) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations. See maximum allowable reverse peak current versus duty cycle graph.

(5) These ratings give a maximum junction temperature of 200°C and thermal resistance (junction-to-case) for the FLB-100 of 35 °C/Watt (derating factor of 28.6 mW/°C); for the FLC-100 29.2°C/Watt (derating factor of 34.3 mW/°C). Junction-to-ambient thermal resistance of 395°C/Watt (derating factor of 2.5 mW/°C) for the FLB-100 and 194°C/Watt (derating factor of 5.15 mW/°C for the FLC-100.

(6) Handle window surface with extreme care to prevent scratching or puncturing semi-rigid silicone resin.

FPA201 • 202 • 203 • 204

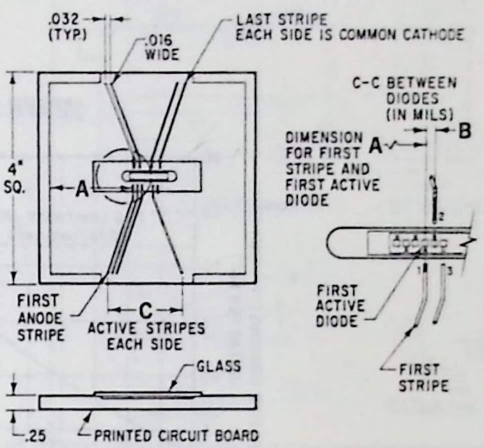
LINEAR INTEGRATED PHOTODIODE ARRAY

SILICON PLANAR* PASSIVATED

PRINTED CIRCUIT BOARD PACKAGE

ENERAL DESCRIPTION—The FPA 200 series linear photodiode arrays are monolithic chips of silicon mounted n a 4″x4″x¼″ printed circuit board. The substrate is a common cathode of the array. Individual anode eads are brought out for each photodiode, and the array is protected by a glass plate. The typical array hown is an FPA-204. The purpose of this type of package is to allow "breadboard evaluation" prior to tilizing complete complex optical array. Typical applications include character recognition, star tracking, odulation transfer function analysis, and industrial process control.

PHYSICAL DIMENSIONS


.032 (TYP)
.016 WIDE
LAST STRIPE EACH SIDE IS COMMON CATHODE
C-C BETWEEN DIODES (IN MILS)
DIMENSION FOR FIRST STRIPE AND FIRST ACTIVE DIODE
A
B
4" SQ.
A
FIRST ANODE STRIPE
C
ACTIVE STRIPES EACH SIDE
FIRST ACTIVE DIODE
FIRST STRIPE
1
2
3
GLASS
.25
PRINTED CIRCUIT BOARD

TYPE	A ±.030	B (MILS)	C	NO. OF ACTIVE DIODES	AREA OF UNIFORM LIGHT SENSITIVITY
FPA 201	1.950	2.0	50	100	2.0 mil^2
FPA 202	1.937	2.5	50	100	3.7 mil^2
FPA 203	1.900	4.0	32/31	63	8.5 mil^2
FPA 204	1.850	6.0	21	42	25 mil^2

BSOLUTE MAXIMUM RATINGS

V_F	Forward Voltage	0.4 Volt
V_R	Reverse Voltage	8 Volts
P	Total Array Power Dissipation at 25°C Ambient (derating factor is 20 μW/°C above 25°C)	1.0 mW
T_A	Operating Temperature, Ambient	−30°C to 75°C
T_{stg}	Storage Temperature, Ambient	−30°C to 100°C

HARACTERISTICS OF THE ELEMENTAL PHOTODIODE

PARAMETER DEVICE	CENTER TO CENTER SPACING	# DIODES	I_D @ $V_R = 7V$ 25°C	I_D @ $V_R = 7V$ 75°C	I_L @ $V_R = 7V$ 25°C** MIN.	MAX.	I_L @ $V_R = 7V$ 75°C** MIN.	MAX.	T_r, T_f @ $V_R = 7V$ $R_L < 50\,k\Omega$	BV $I_D = 1\,\mu A$	TYPICAL DIODE EFFECTIVE AREA (EACH)
FPA 201	.002″	100	60 pA Max.	3 nA Max.	52 nA	80 nA	52 nA	90 nA	2 μs Max.	8 V Min.	4 Mil²
FPA 202	.0025″	100	80 pA Max.	4 nA Max.	80 nA	120 nA	80 nA	145 nA	2 μs Max.	8 V Min.	6.25 Mil²
FPA 203	.004	62	120 pA Max.	6 nA Max.	200 nA	320 nA	200 nA	370 nA	2 μs Max.	8 V Min.	14 Mil²
FPA 204	.006	42	200 pA Max.	10 nA Max.	340 nA	700 nA	340 nA	770 nA	2 μs Max.	8 V Min.	35 Mil²

**Photocurrent at 20 mW/cm² irradiance (See Note 1)

*Planar is a patented Fairchild process.

OTES:

1) Irradiation source is an unfiltered tungsten lamp operated at 2870° K color temperature.
2) Effective area is defined as the area outside of which the photo-response is less than 50% of peak photo-response.

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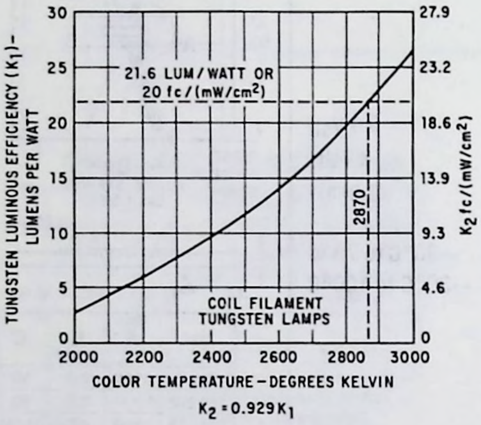
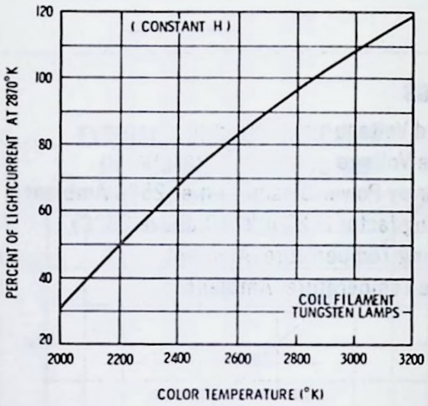
IRRADIATION AND ILLUMINATION

All light current ratings are given in radiometric dimensions (mW/cm²). Conversion to illumination units requires knowledge of the luminous efficiency of the source in lumens per watt of radiated power. For tungsten incandescent sources graph A may be used. Graph B shows the effect of tungsten color temperature upon light current for silicon sensors.

(GRAPH A)



(GRAPH B)



Ft. candles = candle power/distance in ft² = lumens/ft² = (mW/cm²) x 0.929 x lumens per watt.

DEFINITIONS:

IRRADIANCE — Total incident radiant power. Measured in power per unit area. Symbol: H.

ILLUMINANCE — Incident irradiation of wavelengths that are visible to the human eye. Measured in ft. candles.

LUMINOUS EFFICIENCY — Ratio of illuminance to irradiance.

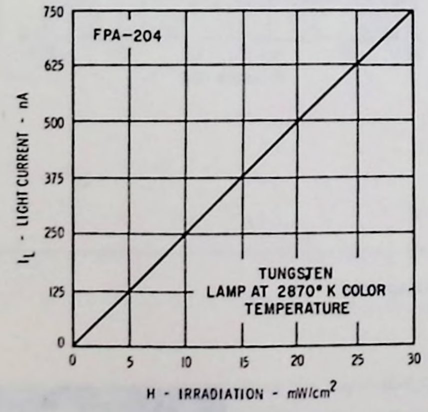
LIGHT CURRENT — The current resulting from the action of light upon a light sensitive device.

DARK CURRENT — Current in a photosensitive device that is effectively shielded from wavelengths to which it responds.

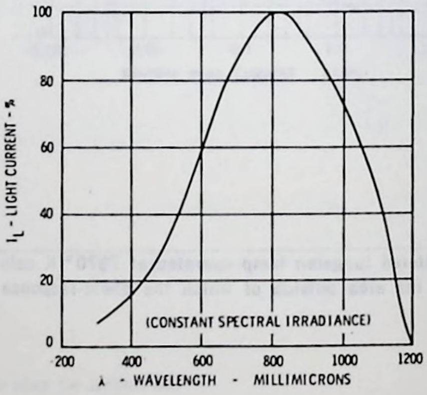
COLOR TEMPERATURE — The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

SPECTRAL IRRADIANCE — The radiant power within a specified wavelength interval that is incident on a surface. Measured in power per unit surface per unit wavelength.

TYPICAL LIGHT CURRENT VERSUS IRRADIATION



TYPICAL LIGHT CURRENT VERSUS WAVE LENGTH



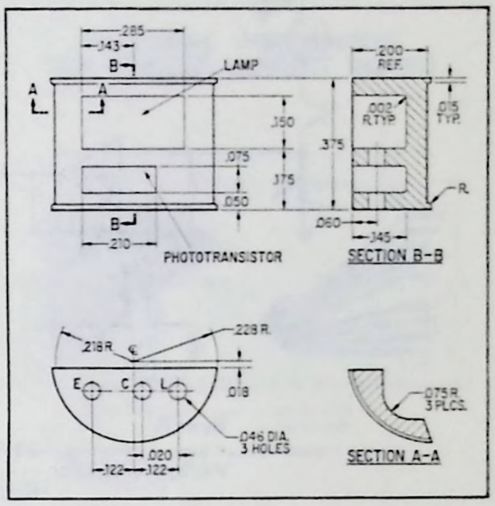
FPA210

LIGHT REFLECTION TRANSDUCER

PHOTOTRANSISTOR/ENCAPSULATED LAMP

GENERAL DESCRIPTION: The FPA 210 is a plastic package containing a miniature incandescent light bulb and a FPM 100 Phototransistor die. Possible applications include process control, medical technology (heartbeat monitor), and character recognition.

DIE DESCRIPTION: The FPM 100 Phototransistor die has a large photosensitive base, affording exceptional sensitivity. The spectral response extending from .44 to 1.1 microns is compatible with the tungsten light source.



DIE ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	40		Volts	$I_C = 0.1$ mA	$H \leqq 0.1\ \mu W/cm^2$
$V_{CE(sat)}$	Collector Saturation Voltage (Note 1)		0.3	Volts	$I_C = 0.4$ mA	$H = 20\ mW/cm^2$
I_{L-1}	Light Current (Note 1)	0.8		mA	$V_{CE} = 5.0$ V	$H = 20\ mW/cm^2$
I_D	Dark Current		0.1	μA	$V_{CE} = 15$ V	$H \leqq 0.1\ \mu W/cm^2$
BV_{ECO}	Emitter-Collector Breakdown Voltage	5		Volts	$I_C = 0.1$ mA	$H \leqq 0.1\ \mu W/cm^2$

FPA-210 LIGHT REFLECTION TRANSDUCER CHARACTERISTICS

Operating Temperature Range −10°C to 80°C

	TYPICAL (see note 2)	TEST CONDITIONS (see note 3)
I_{CE} (see note 4)	35 μAmp	2 steradians of 90% white at 2 cm distance
I_{CE} (see note 4)	50 μAmp	2 π steradians of 90% white at 2 cm distance
I_{CE} (see note 5)	70 μAmp	2 steradians of 90% white at 2 cm distance
I_{CE} (see note 5)	100 μAmp	2 π steradians of 90% white at 2 cm distance
I_{CE} (dark) (see note 4)	250 pAmp	irradiance $< 0.1\ \mu$watt cm^{-2} lamp OFF, $V_{CE} = 5$ volts
I_{CE} (black) (see note 5)	500 pAmp	reflectance $< 1\%$ over 2 π sr., lamp ON
I_{CE} (ambient light) (see note 4)	0.9 μAmp	20 ft. cd. parallel to face, lamp OFF

DEFINITIONS

IRRADIATION — Total incident radiant energy. Measured in power per unit area. Symbol: H

ILLUMINATION — Incident irradiation of wavelengths which are visible to the human eye. Measured in ft. candles.

LUMINOUS EFFICIENCY — Ratio of illumination to irradiation.

LIGHT CURRENT — The current resulting from the action of light upon a light sensitive device.

DARK CURRENT — Current in a photosensitive device which is effectively shielded from wavelengths to which it responds.

COLOR TEMPERATURE — The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

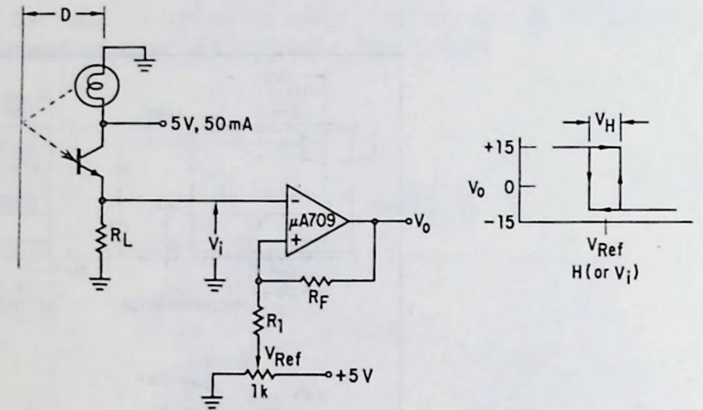
NOTES:

(1) Irradiation source is an unfiltered tungsten lamp at 2870°K color temperature.
(2) Lamp current 50 mA (5 volts), $V_{CE} = 5$ volts.
(3) Eastman Kodak neutral white test card with 90% diffuse reflectance.
(4) Case temp. 25°C, lamp operated ON 5% duty cycle.
(5) Case temp. 40°C, lamp operated ON continuously at 25°C ambient.

FAIRCHILD LIGHT REFLECTION TRANSDUCER FPA210

The following circuits are examples of amplifying systems that have been used in conjunction with the FPA 210.

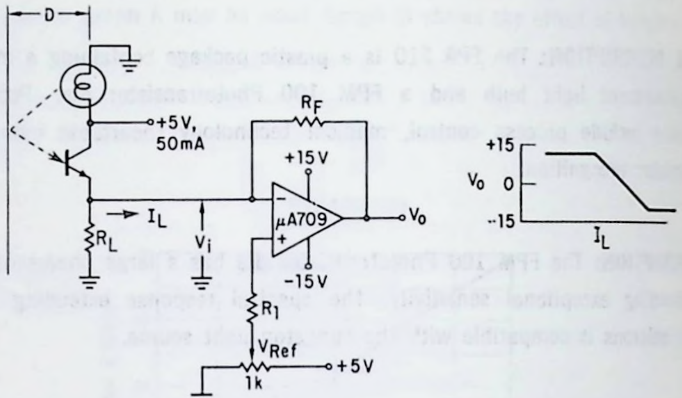
ON/OFF DETECTOR


D
5V, 50mA
R_L
V_i
μA709
V_O
R_F
R_1
V_{Ref}
1k
+5V
V_H
+15
V_O 0
−15
V_{Ref}
H (or V_i)

$R_1 = R_L$

V_H (hysteresis) $\approx \frac{30\,R_1}{R_1 + R_F}$

LINEAR AMPLIFIER CIRCUIT


D
+5V, 50mA
R_F
+15V
I_L
R_L
V_i
μA709
V_O
−15V
R_1
V_{Ref}
1k
+5V
+15
V_O 0
−15
I_L

$R_L \leq 100\,k$

$I_L \propto \frac{B\,R}{D^4}$

B = Brightness
R = Reflectance of subject
D = Distance to subject

$V_i \approx R_L I_L$

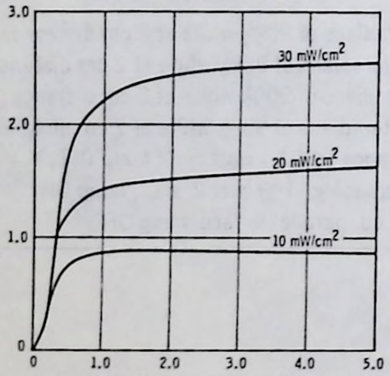
$A_V \approx \frac{R_F}{R_L}$

$R_1 = R_L$ for best stability

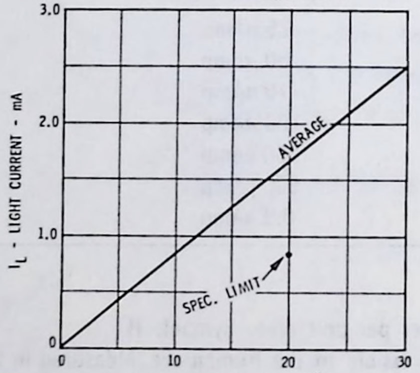
$V_O \propto A_V \frac{R}{D^4}$

V_{Ref} = offset adjustment to compensate for contact reflected illumination or ambient light.

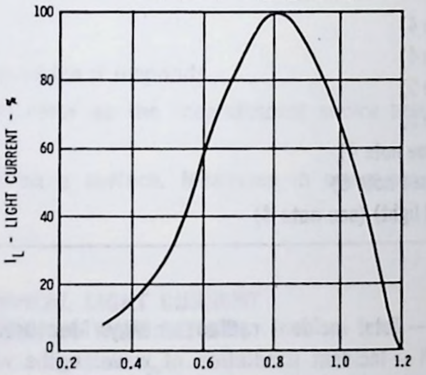
TYPICAL COLLECTOR CHARACTERISTICS



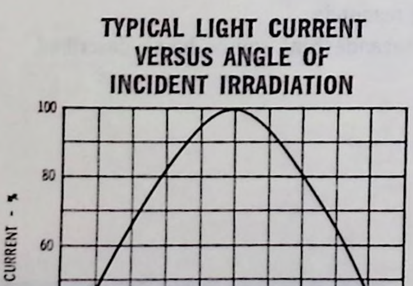
TYPICAL LIGHT CURRENT VERSUS IRRADIATION



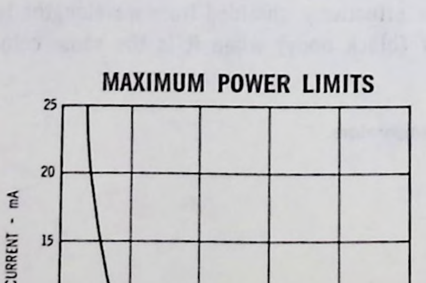
TYPICAL LIGHT CURRENT VERSUS WAVELENGTH



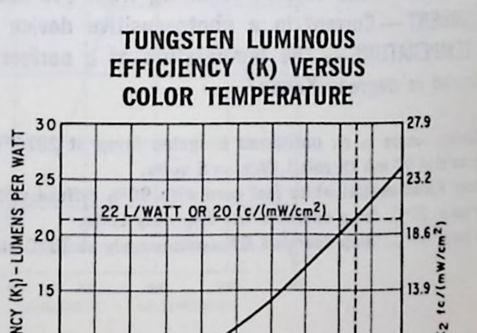
TYPICAL LIGHT CURRENT VERSUS ANGLE OF INCIDENT IRRADIATION



MAXIMUM POWER LIMITS



TUNGSTEN LUMINOUS EFFICIENCY (K) VERSUS COLOR TEMPERATURE



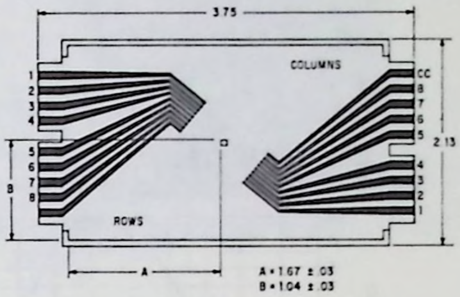
FPA301

8 X 8 INTEGRATED PHOTOTRANSISTOR ARRAY

SILICON PLANAR* PASSIVATED

GENERAL DESCRIPTION — The FPA301 is an 8 by 8 array of dual emitter phototransistors of monolithic construction. The silicon substrate serves as the common collector. Row emitters and column emitters are connected by metalization strips to form a matrix of word rows and bit columns. Word rows are interrogated one at a time by switching them from STANDBY to the READ state. Amplified photo currents then appear simultaneously at the bit column terminals from each illuminated photosensitive element in the row. Word rows may be interrogated at random or sequentially. The array is designed to be operated as a read only optical memory (ROOM). It may also be used for low resolution image scanning applications.

PHYSICAL DIMENSIONS OF PRINTED CIRCUIT BOARD



DIMENSIONS A & B LOCATE THE ROW 1 COLUMN 1 ELEMENT

OPERATING PARAMETERS — The array has 5 mil center to center spacing along row and column axes. Each photo sensitive element has a nominal effective area of 15 square mils or 0.01 square mm. The relative spectral response is shown in Fig. 1. The monolithic array is mounted on a printed circuit board with 17 fanned-out terminals. Emitter follower operation is illustrated by the equivalent circuit of Fig. 2. The following three equations are a useful guide for establishing the standby voltage, V_{STBY}, and the read voltage, V_{READ}. The substrate voltage, V_{SUB}, is the voltage at the common collector (substrate) terminal, S, for all elements. The voltage V_{SIG} is defined as the maximum possible signal in the bit column sequence, $e_{r1}, e_{r2}, \ldots e_{r8}$ for a particular application.

$$-7.0 \text{ VOLTS} \leq V_{STBY} \leq -1.0 \text{ VOLT}$$

$$V_{SIG} + 1.0 \text{ VOLT} \leq V_{READ} \leq +7.0 \text{ VOLTS}$$

$$V_{SIG} + 2.0 \text{ VOLTS} \leq V_{SUB} \leq 13.0 \text{ VOLTS}$$

ABSOLUTE MAXIMUM RATINGS

Operating temperature, ambient	−30°C to 75°C
Total array electrical power dissipation†	100 mW
(derating factor is 2 mW per °C above 25°C)	
Irradiation level, all wavelengths	1.0 W/cm²
Photocurrent per column†	150 μA

ELECTRICAL CHARACTERISTICS

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
A_e	Photosensitive Area of Each Element		15		mil²	
BV_{SR-C}	Substrate to Row or Column Breakdown Voltage	20			Volts	$I_{substrate} = 10\mu A$
BV_{RS}	Row to Substrate Breakdown Voltage	7			Volts	$I_{substrate} = 10\mu A$
BV_{CS}	Column to Substrate Breakdown Voltage	7			Volts	$I_{substrate} = 10\mu A$
$1 + h_{FE}$	Photocurrent Gain	10	15	30		
I_{STBY}	Leakage Current Per Column, All Rows in STBY		−10	−50	pA	See Note 1
I_D	Dark Current Per Column†		50	500	pA	$H < 0.1\ \mu W/cm^2$ See Note 1
I_E	Photocurrent Per Column†	0.1		1.0	μA	$H = 5mW/cm^2$ See Note 2
t_{sw}	Word Row Switching Time, 10% to 90%		50	100	ns	$H = 5mW/cm^2$ $R_L = 1\ k\Omega$ See Notes 2 and 3
$\frac{I_{Emax} - I_{Emin}}{I_{Emean}}$	Uniformity of Column Photocurrent Within Each Array†		0.4			$H = 5mW/cm^2$ See Note 2

†Any single word row in the READ state. Rows in STBY contribute to total power.

*Planar is a patented Fairchild process

NOTES:

(1) $V_{STBY} = -2$ volts, $V_{READ} = 2$ volts, $V_{SUB} = 5$ volts.
(2) Tungsten source at 2870°K color temperature, same voltages as Note 1.
(3) Word row switching time is proportional to R_L when $R_L > 1\ k\Omega$. See Figure 2.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

IRRADIATION AND ILLUMINATION

All irradiation levels are given in radiometric units (mW/cm²). Conversion to illumination units requires knowledge of the luminous efficiency of the source in lumens per watt of radiated power. For tungsten incandescent sources, Figure 4 may be used. Figure 5 shows the effect of tungsten color temperature upon light current for silicon sensors at constant H.

TYPICAL SPECTRAL RESPONSE
(Not Showing Oxide ± 5% Interference Structure)

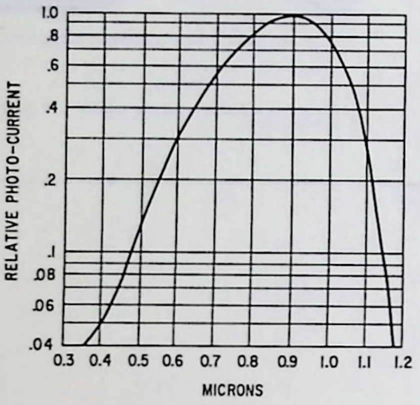
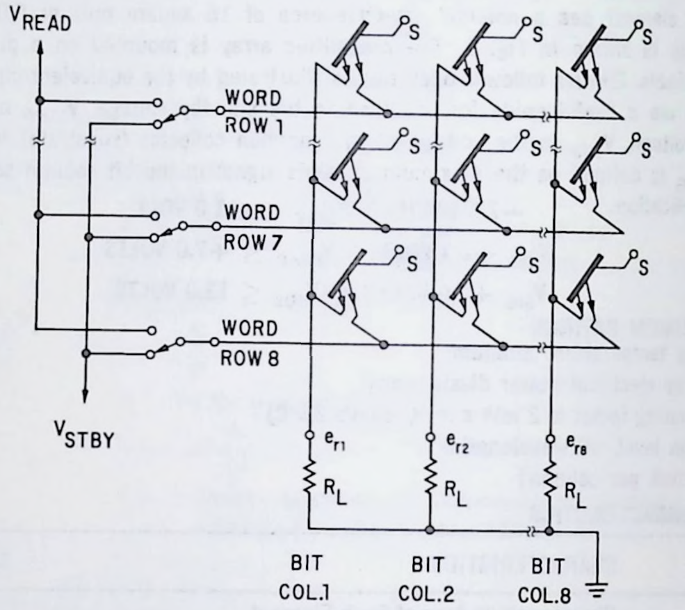


Fig. 1

EQUIVALENT CIRCUIT MATRIX SHOWING TYPICAL OPERATION


V_{READ}
WORD
ROW 1
WORD
ROW 7
WORD
ROW 8
V_{STBY}
S
e_{r1}
e_{r2}
e_{r8}
R_L
BIT
COL.1
BIT
COL.2
BIT
COL.8

The Substrate Terminal, S, is a common collector for all elements.

r = Row Designation

Fig. 2

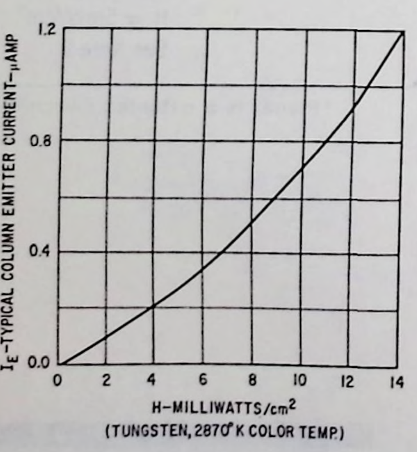


Fig. 3

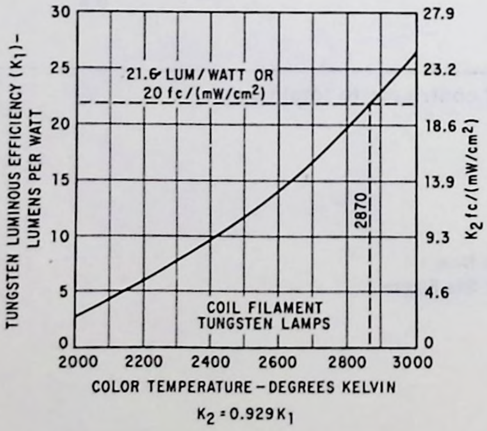


Fig. 4

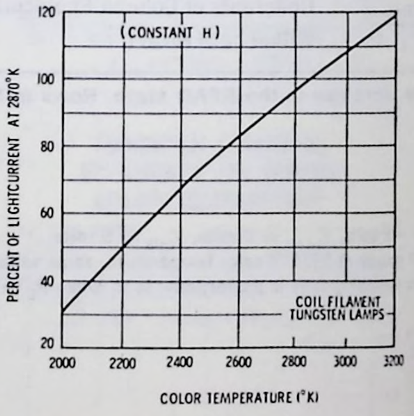


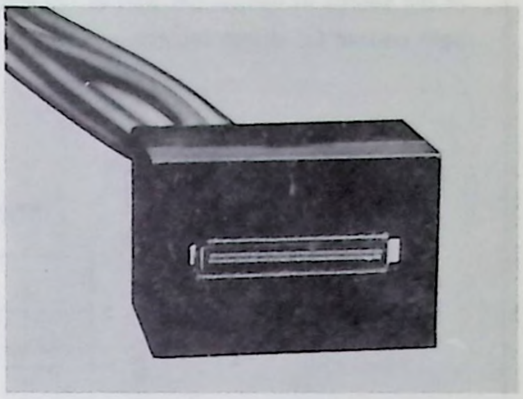
Fig. 5

FPA 500

LINEAR INTEGRATED PHOTODIODE ARRAY

SILICON PLANAR* PASSIVATED

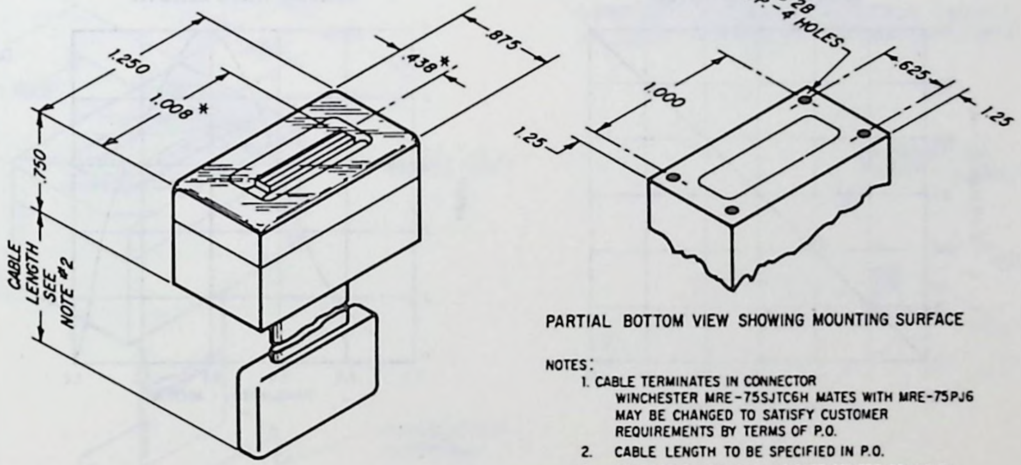
GENERAL DESCRIPTION — The FPA 500 photodiode array consists of 126 photodiodes on 6 mil centers forming a linear array 0.756 inch in length as measured between centers of the end photodiodes. The array is fabricated as a monolithic silicon structure. Each photodiode has a 4 x 6 mil area of uniform light sensitivity and a total effective sensitive area of approximately 35 mil². The package includes a thin glass window positioned close to the array face; it is not hermetically sealed.



CHARACTERISTICS OF THE ELEMENTAL PHOTODIODES

SYMBOL	CHARACTERISTIC	MIN.	NOM.	MAX.	CONDITIONS
I_D	Dark Current		20 pA	200 pA	7 V 25°C
				30 nA	7 V 100°C
I_L	Light current at20mW/cm²	340 nA	480 nA	700 nA	7 V 25°C
		70 nA		200 nA	7 V 100°C
t_r, t_f	Risetime, Falltime			2 μs	7 V $R_L < 50\ k\Omega$
BV	Breakdown Voltage	8 V			$I_D = 1\ \mu A$

* Planar is a Patented Fairchild Process



PARTIAL BOTTOM VIEW SHOWING MOUNTING SURFACE

NOTES:
1. CABLE TERMINATES IN CONNECTOR WINCHESTER MRE-75SJTC6H MATES WITH MRE-75PJ6 MAY BE CHANGED TO SATISFY CUSTOMER REQUIREMENTS BY TERMS OF P.O.
2. CABLE LENGTH TO BE SPECIFIED IN P.O.
3. STARRED DIMENSIONS INDICATE CENTER OF LIGHT SOURCE NO. 1 IN THE MATRIX ARRAY

NOTE:
Irradiation source is an unfiltered tungsten lamp operated at 2870°K color temperature.

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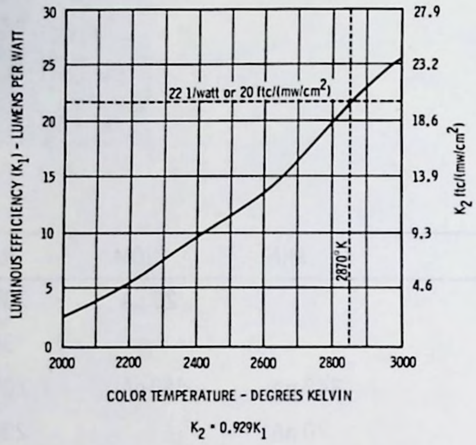
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

IRRADIANCE AND ILLUMINANCE

All light current ratings are given in radiometric dimensions (mW/cm²). Conversion to illumination units requires knowledge of the luminous efficie of the source in lumens per watt of radiated power. For incandescent sources graph A may be used. Graph B shows the effect of color temperature up light current for silicon sensors.

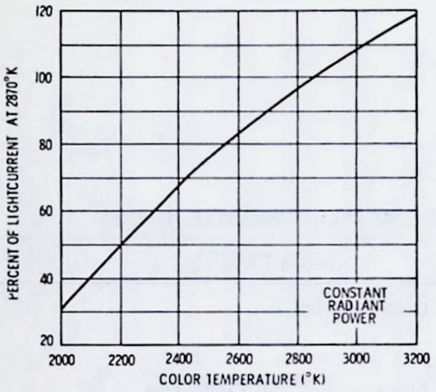
(GRAPH A)

INCANDESCENT SOURCES



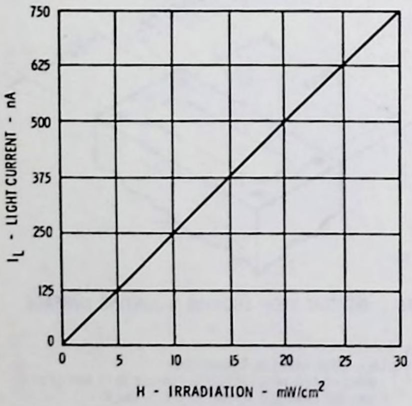
(GRAPH B)

COLOR TEMPERATURE VERSUS LIGHT CURRENT

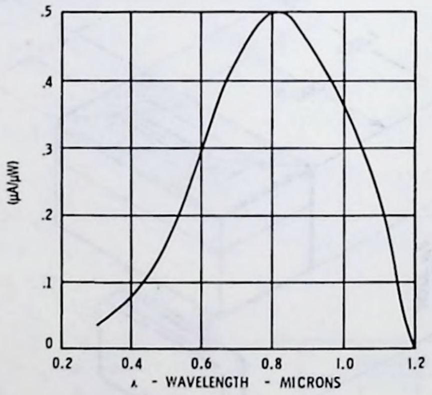


Ft. candles = candle power/distance in ft² = lumens/ft² = mW/cm² × 0.929 × lumens per watt.

TYPICAL LIGHT CURRENT VERSUS IRRADIATION



TYPICAL LIGHT CURRENT VERSUS WAVE LENGTH



DEFINITIONS

IRRADIANCE — Total incident radiant energy. Measured in power per unit area. Symbol: H.

ILLUMINANCE — Incident irradiation of wavelengths which are visible to the human eye. Measured in ft. candles.

LUMINOUS EFFICIENCY — Ratio of illuminance to irradiance.

LIGHT CURRENT — The current resulting from the action of light upon a light sensitive device.

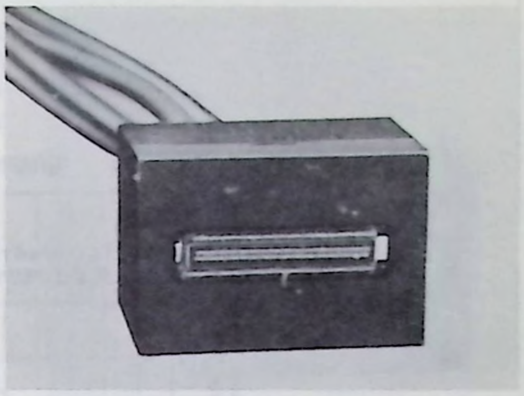
DARK CURRENT — Current in a photosensitive device which is effectively shielded from wavelengths to which it responds.

COLOR TEMPERATURE — The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

FPA505

LINEAR INTEGRATED PHOTODIODE ARRAY

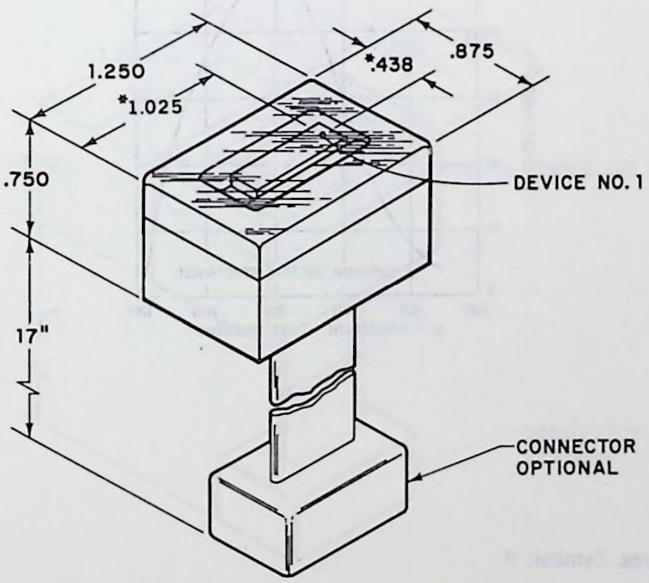
SILICON PLANAR* PASSIVATED



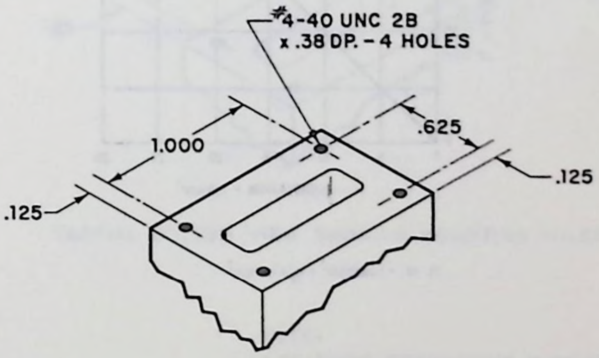
GENERAL DESCRIPTION—The FPA 505 photodiode array consists of 320 photodiodes on 2.5 mil centers forming a linear array .800 inch in length as measured between centers of the end photodiodes. The array is fabricated as a monolithic silicon structure. Each photodiode has a 2.0x2.0 mil area of uniform light sensitivity and a total effective sensitive area of approximately 5.6 mil². The package includes a thin glass window positioned close to the array face; it is not hermetically sealed.

CHARACTERISTICS OF THE ELEMENTAL PHOTODIODES

SYMBOL	CHARACTERISTICS	MIN.	MAX.	CONDITIONS
I_D	Dark Current		80 pA	7 V 25°C
			12 nA	7 V 100°C
I_L	Photocurrent at 20 mW/cm²	80 nA	120 nA	7 V 25°C (see Note)
		60 nA	160 nA	7 V 100°C (see Note)
t_r, t_f	Risetime, Falltime		2 μs	7 V $R_L < 50\ k\Omega$
BV	Breakdown Voltage	8 V		$I_R = 1\ \mu A$



NOTE:
* STARRED DIMENSIONS INDICATE CENTER OF LIGHT SENSOR NO. 1 IN MATRIX ARRAY



PARTIAL BOTTOM VIEW SHOWING MOUNTING HOLES

*Planar is a patented Fairchild proc

NOTE:
rradiation source is an unfiltered tungsten lamp operated at 2870°K color temperature.

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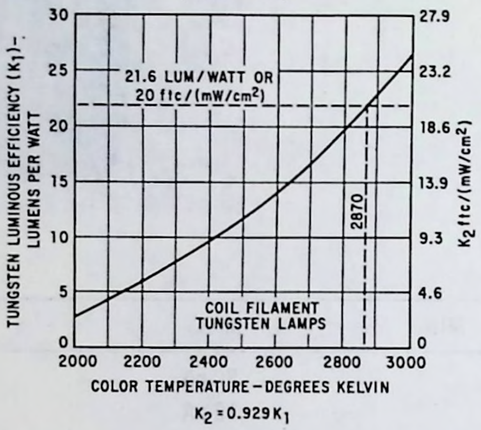
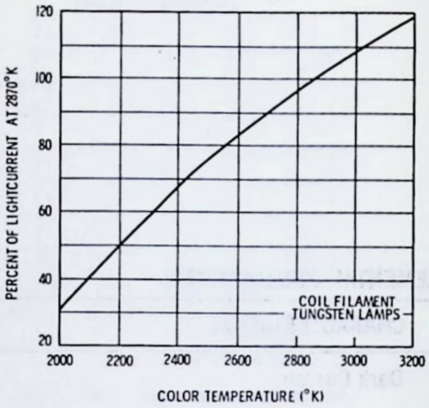
IRRADIATION AND ILLUMINATION

All light current ratings are given in radiometric dimensions (mW/cm²). Conversion to illumination units requires knowledge of the luminous efficiency of the source in lumens per watt of radiated power. For Tungsten incandescent sources graph A may be used. Graph B shows the effect of Tungsten color temperature upon light current for silicon sensors.

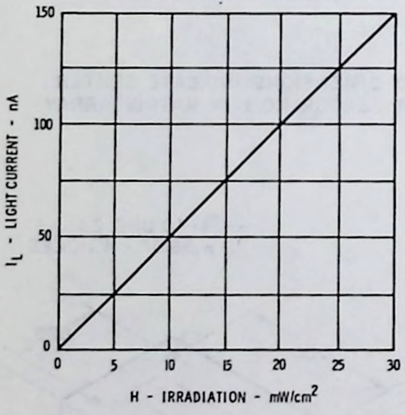
(GRAPH A)



(GRAPH B)

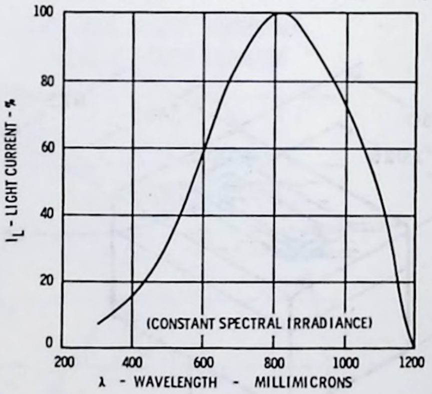


TYPICAL LIGHT CURRENT VERSUS IRRADIATION



Ft. cd. = Lumens/ft^2 = K_2 x mW/cm^2

TYPICAL LIGHT CURRENT VERSUS WAVE LENGTH



DEFINITIONS:

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ILLUMINANCE — Incident irradiation of wavelengths that are visible to the human eye. Measured in ft. candles.

LUMINOUS EFFICIENCY — Ratio of illuminance to irradiance.

LIGHT CURRENT — The current resulting from the action of light upon a light sensitive device.

DARK CURRENT — Current in a photosensitive device that is effectively shielded from wavelengths to which it responds.

COLOR TEMPERATURE — The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

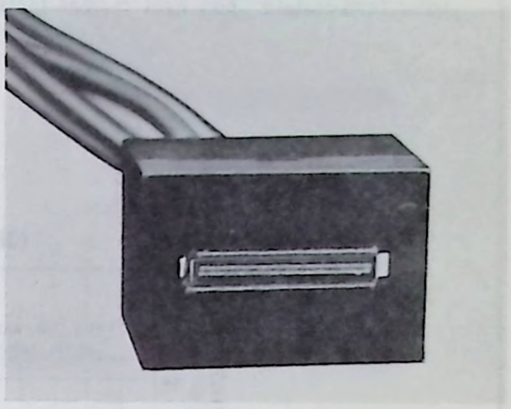
SPECTRAL IRRADIANCE — The radiant power within a specified wavelength interval that is incident on a surface. Measured in power per unit surface per unit wavelength.

FPA507

LINEAR INTEGRATED PHOTODIODE ARRAY

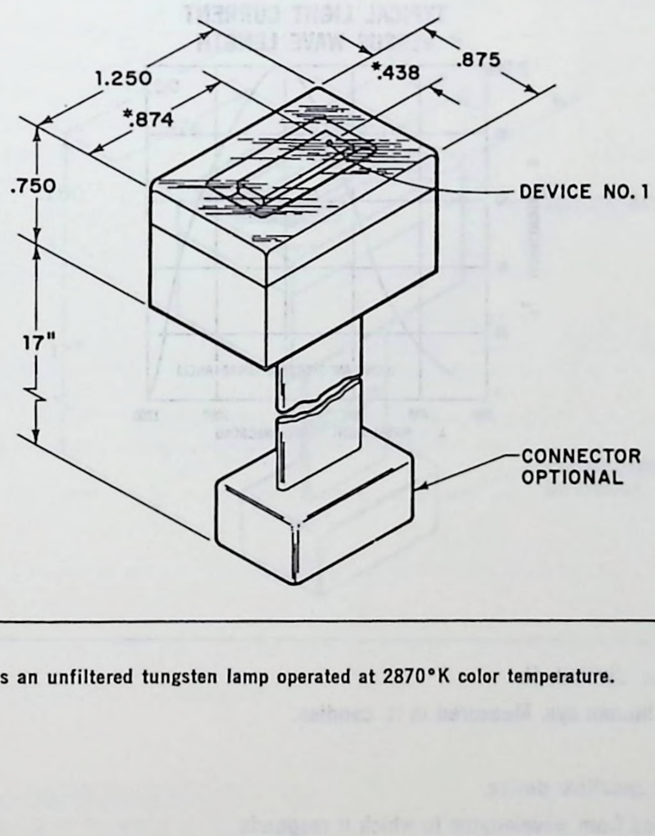
SILICON PLANAR* PASSIVATED

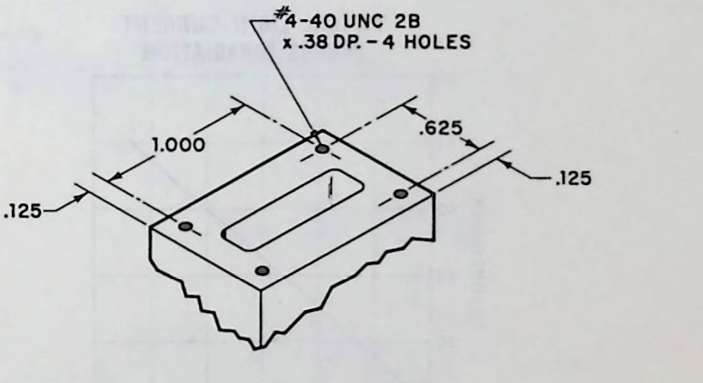
GENERAL DESCRIPTION—The FPA 507 photodiode array consists of 250 photodiodes on 2 mil centers forming a linear array .500 inch in length as measured between centers of the end photodiodes. The array is fabricated as a monolithic silicon structure. Each photodiode has a 1.5x1.5 mil area of uniform light sensitivity and a total effective sensitive area of approximately 3.5 mil². The package includes a thin glass window positioned close to the array face; it is not hermetically sealed.



CHARACTERISTICS OF THE ELEMENTAL PHOTODIODES

SYMBOL	CHARACTERISTICS	VALUE MIN.	 NOM.	 MAX.	CONDITIONS
I_D	Dark Current			60 nA	7 V 25°C
				10 nA	7 V 100°C
I_L	Photocurrent at 20 mW/cm²	52 nA		80 nA	7 V 25°C (see Note)
		40 nA		100 nA	7 V 100°C (see Note)
t_r, t_f	Risetime, Falltime			2 μs	7 V $R_L < 50\ k\Omega$
BV	Breakdown Voltage	8 V			$I_R = 1\ \mu A$





PARTIAL BOTTOM VIEW SHOWING MOUNTING HOLES

NOTE:
* STARRED DIMENSIONS INDICATE CENTER OF LIGHT SENSOR NO. 1 IN MATRIX ARRAY

NOTE:
Irradiation source is an unfiltered tungsten lamp operated at 2870°K color temperature.

*Planar is a patented Fairchild proc

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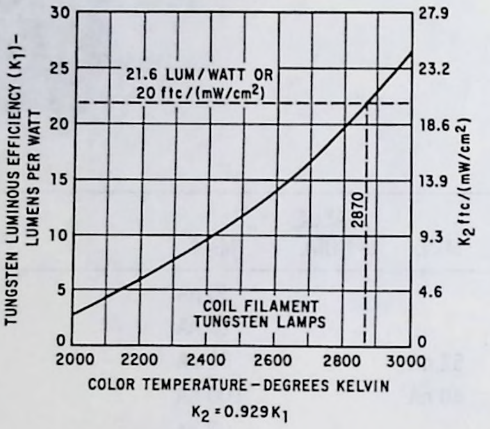
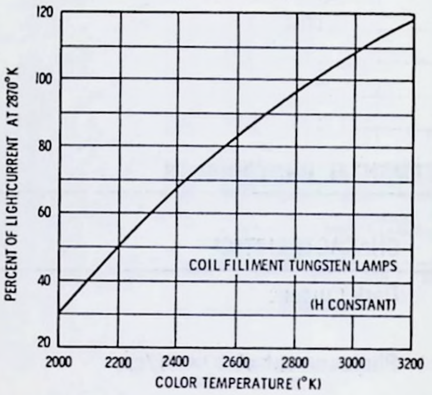
IRRADIATION AND ILLUMINATION

All light current ratings are given in radiometric dimensions (mW/cm²). Conversion to illumination units requires knowledge of the luminous efficiency of the source in lumens per watt of radiated power. For Tungsten incandescent sources graph A may be used. Graph B shows the effect of Tungsten color temperature upon light current for silicon photosensors.

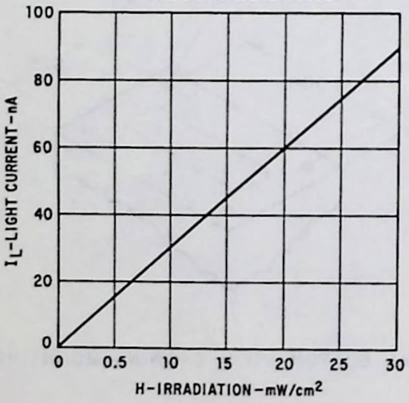
(GRAPH A)



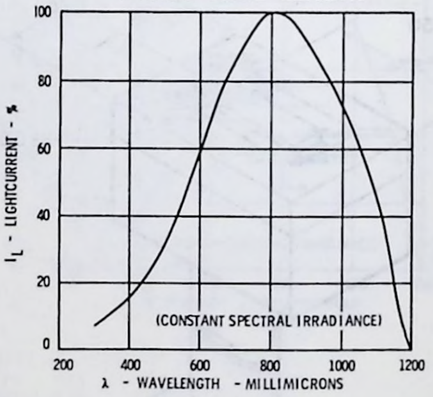
(GRAPH B)



TYPICAL LIGHT CURRENT VERSUS IRRADIATION



TYPICAL LIGHT CURRENT VERSUS WAVE LENGTH



Ft.-cd. = Lumens/ft^2 = K_2 x mW/cm^2

DEFINITIONS:

IRRADIANCE — Total incident radiant power. Measured in power per unit area. Symbol: H.

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DARK CURRENT — Current in a photosensitive device that is effectively shielded from wavelengths to which it responds.

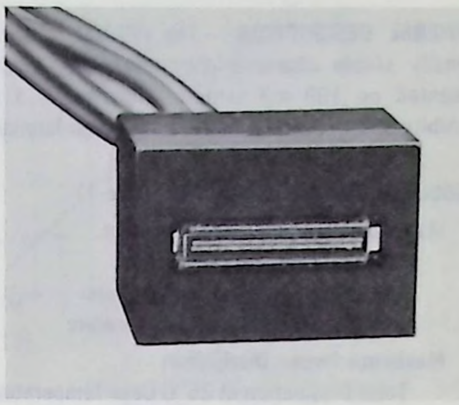
COLOR TEMPERATURE — The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

SPECTRAL IRRADIANCE — The radiant power within a specified wavelength interval that is incident on a surface. Measured in power per unit surface per unit wavelength.

FPA509

LINEAR INTEGRATED PHOTODIODE ARRAY

SILICON PLANAR* PASSIVATED



ENERAL DESCRIPTION—The FPA509 photodiode array consists of 125 photodiodes on 4 mil centers forming linear array 0.496 inch in length as measured between centers of the end photodiodes. The array is abricated as a monolithic silicon structure. The substrate is a common cathode of the array. Each photoiode has a 2.5 x 3.5 mil area of uniform light sensitivity and a total effective sensitive area of approximately 4 mil². The package includes a thin glass window positioned close to the array face; typical applications nclude optical character recognition, star tracking, modulation transfer function analysis, and industrial rocess control.

BSOLUTE MAXIMUM RATINGS

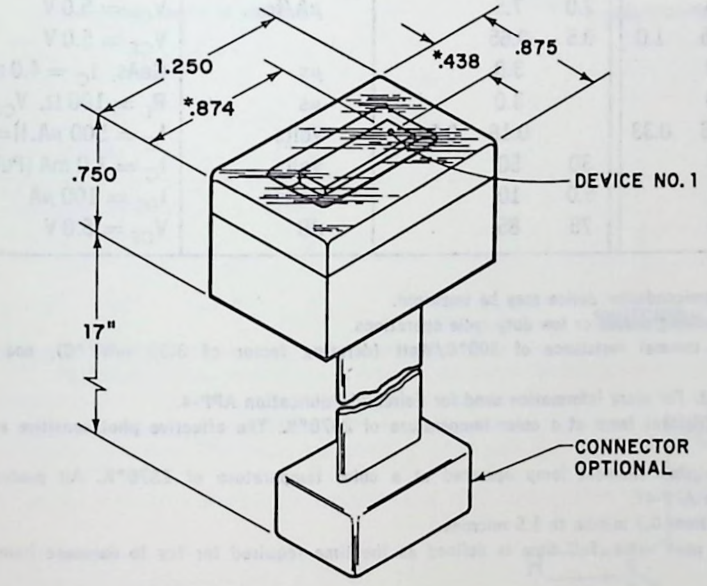
V_R	Reverse voltage	8 Volts
V_F	Forward voltage	0.4 Volt
T_A	Operating temperature, ambient	−30°C to +100°C
T_{stg}	Storage temperature, ambient	−30°C to 100°C

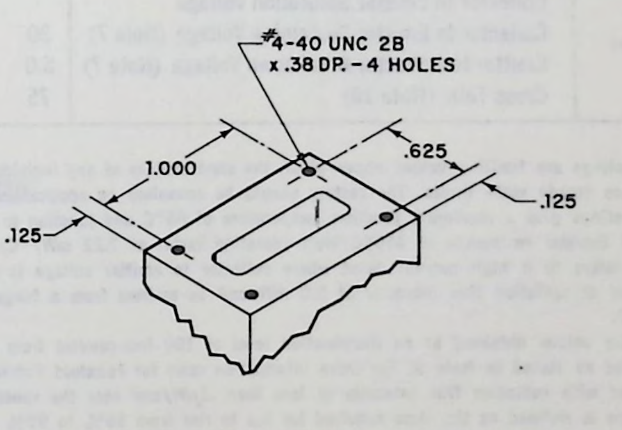
HARACTERISTICS OF THE ELEMENTAL PHOTODIODES (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	CONDITIONS
I_D	Dark Current		120 pA	$V_R = 7$ V
			20 nA	$V_R = 7$ V $T_A = 100$°C
I_L	Photocurrent at 20 mW/cm² (See Note)	200 nA	320 nA	$V_R = 7$ V
		160 nA	400 nA	$V_R = 7$ V $T_A = 100$°C
t_r, t_f	Risetime, Falltime		2 μs	$V_R = 7$V, $R_L < 50$ kΩ
BV	Breakdown Voltage	8 V		$I_D = 1$ μA

OTE:
rradiation source is an unfiltered tungsten lamp operated at 2870°K color temperature.

NOTE:
* STARRED DIMENSIONS INDICATE CENTER OF LIGHT SENSOR NO. 1 IN MATRIX ARRAY





PARTIAL BOTTOM VIEW SHOWING MOUNTING HOLES

*Planar is a patented Fairchild process.

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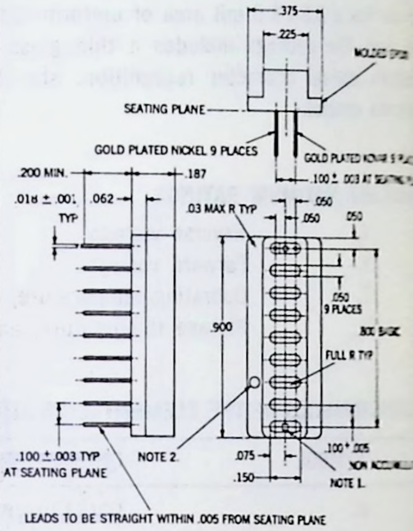
FPA700 • FPA700A
PHOTOTRANSISTOR TAPE READER ARRAY
NPN PLANAR* PHOTOTRANSISTOR TAPE READER ARRAY

GENERAL DESCRIPTION — The FPA700 is a nine element NPN Planar phototransistor array having exceptionally stable characteristics and high illumination sensitivity. Each transistor is electrically isolated and mounted on 100 mil centers. The case is a plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures/Humidity	
Storage Temperature	−40°C to +100°C
Operating Junction Temperature	−40°C to +85°C
Relative Humidity at Temperature	95% at 65°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 & 3)	200 mW/Cell
at 25°C Ambient Temperature (Notes 2 & 3)	133 mW/Cell
	1200 mW -Total
Maximum Voltages (Note 7)	
V_{CEO} Collector to Emitter Sustaining Voltage (Note 4)	30 Volts
Maximum Current	
I_C Collector Current	25 mA/Cell

PHYSICAL DIMENSIONS



NOTE 1: 1-ACTIVE AREA IS WITHIN A .050 DIAMETER CIRC
CENTER OF CIRCLE IS WITHIN .010 OF ABSOLUTE CENTERLINE
NOTE 2 : EMITTER SIDE DEFINED BY WHITE DOT.

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		FPA700A			FPA700				
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
I_{CEO}	Collector Dark Current/Cell (Note 7)		2.0	100		2.0	100	nA	$V_{CE} = 5.0$ V
RS_{CE}	Radiometric Sensitivity/Cell (Note 5)	40	150		40	150		μA/mW/cm²	$V_{CE} = 5.0$ V
LS_{CE}	Luminous Sensitivity/Cell (Note 6)	2.0	7.5		2.0	7.5		μA/fc	$V_{CE} = 5.0$ V
S_{min}/S_{max}	Matching Factor (Notes 5 & 9)	0.75	0.85	1.0	0.5	0.65			$V_{CE} = 5.0$ V
t_r	Light Current Rise Time (Note 8)		3.0			3.0		μs	GaAs, $I_C = 4.0$ mA
t_f	Light Current Fall Time (Note 8)		3.0			3.0		μs	$R_L = 100\ \Omega$, $V_{CC} = 5.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.16	0.33		0.16	0.33	Volts	$I_C = 500\ \mu A$, H = 20 mW/c
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 7)	30	50		30	50		Volts	$I_C = 1.0$ mA (Pulsed)
BV_{ECO}	Emitter to Collector Breakdown Voltage (Note 7)	5.0	10		5.0	10		Volts	$I_{EC} = 100\ \mu A$
X_T	Cross Talk (Note 10)	75	85		75	85		dB	$V_{CE} = 5.0$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 85°C and junction to case thermal resistance of 300°C/Watt (derating factor of 3.33 mW/°C), and a junction ambient thermal resistance of 450°C/Watt (derating factor of 2.22 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

(5) Measured at radiation flux intensity of 5.0 mW/cm² as emitted from a tungsten filament lamp at a color temperature of 2870°K. The effective photosensitive area is typ 0.8 mm².

(6) These are values obtained at an illumination level of 100 foot-candles from a tungsten filament lamp operated at a color temperature of 2870°K. All production tests performed as stated in Note 5. For more information send for Fairchild Publication APP-47.

(7) Measured with radiation flux intensity of less than .1μW/cm² over the spectrum from 0.1 micron to 1.5 microns.

(8) Rise time is defined as the time required for Ice to rise from 10% to 90% of a peak value. Fall time is defined as the time required for Ice to decrease from 90% to 1 of a peak value. For more information send for Fairchild Publication APP-93.

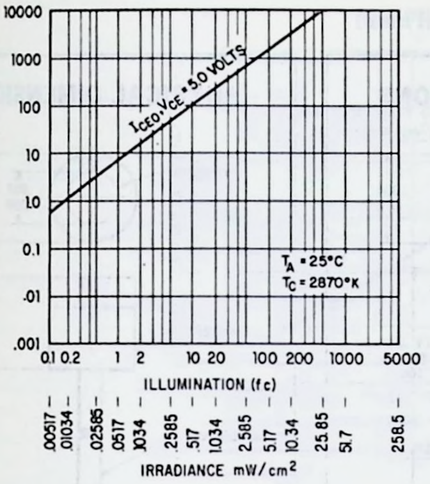
(9) Matching factor-ratio of minimum sensitivity of maximum sensitivity of any two cells.

(10) Cross Talk: ratio of signal between two adjacent cells with H = 50 mW/cm² at 2870°K through 72 mil hole (STD paper tape) on one cell, the other being dark. T optical density = 3.5.

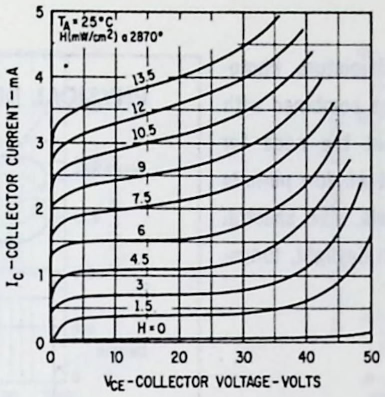
*Planar is a patented Fairchild process

TYPICAL ELECTRICAL CHARACTERISTICS

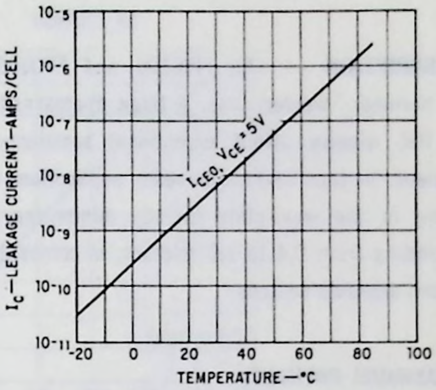
LIGHT CURRENT CHARACTERISTICS



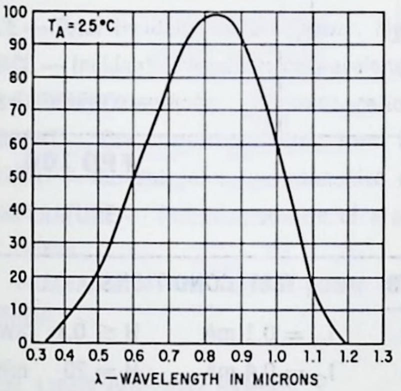
LIGHT CURRENT VERSUS COLLECTOR VOLTAGE



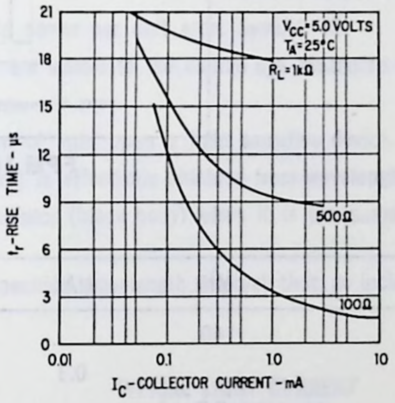
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



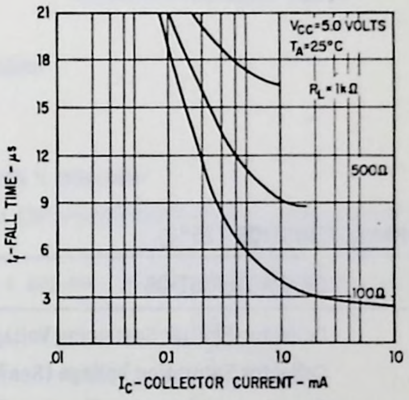
SPECTRAL CHARACTERISTICS



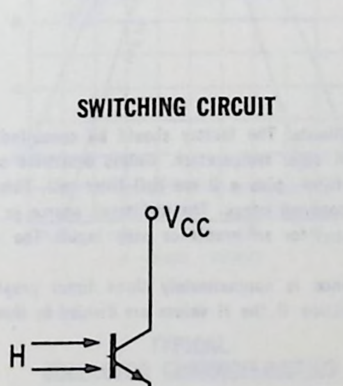
RISE TIME VERSUS COLLECTOR CURRENT



FALL TIME VERSUS COLLECTOR CURRENT



SWITCHING CIRCUIT



SOURCE — Ga As

FPM100 • FPO100

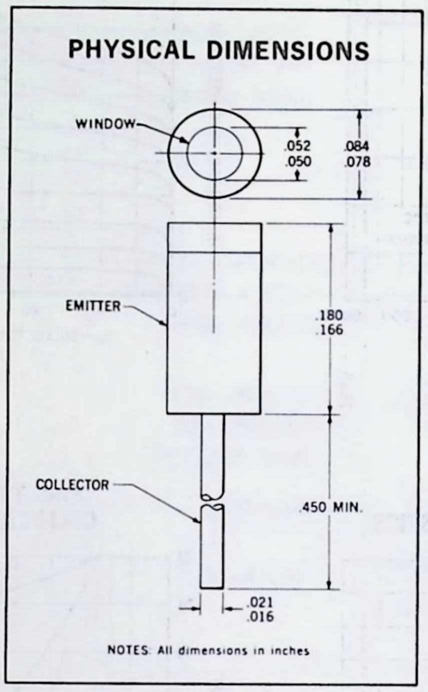
SILICON NPN PLANAR* PASSIVATED PHOTOTRANSISTOR

TWO TERMINAL COAXIAL PACKAGE

GENERAL DESCRIPTION — The FPM100 and FPO100 are Miniature Photosensors in a hermetic, welded case. A large photosensitive base combined with an optically flat window afford exceptional sensitivity without the need for critical alignment. In tape and card reader applications the flat window permits flush mounting in the wear-plate thereby minimizing cross-talk. The spectral response, extending from 0.4 to 1.1 microns, is compatible with daylight, tungsten, and gallium arsenide sources.

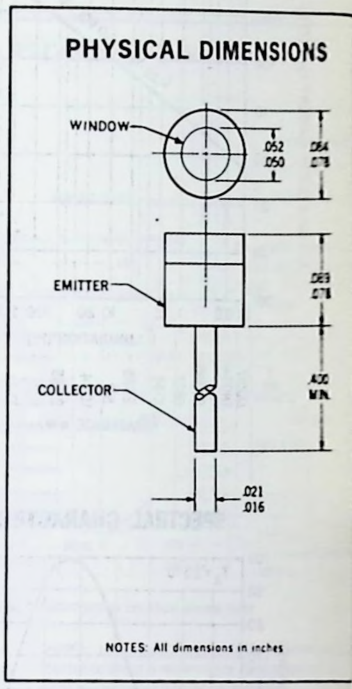
ABSOLUTE MAXIMUM RATINGS

V_{CE}	Collector-Emitter Voltage	40 V
V_{EC}	Emitter-Collector Voltage	5 V
P	Power Dissipation (25°C Ambient) (See Note 1)	75 mW
T_A	Operating Temperature, Ambient	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +200°C


PHYSICAL DIMENSIONS

NOTES: All dimensions in inches

FPM 100


PHYSICAL DIMENSIONS

NOTES: All dimensions in inches

FPO 100

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	40		Volts	$I_C = 0.1$ mA	$H \leqq 0.1$ μW/cm²
$V_{CE(sat)}$	Collector Saturation Voltage (See Note 2)		0.3	Volts	$I_C = 0.4$ mA	$H = 20$ mW/cm²
$I_{CE(L)}$	Collector Light Current (See Note 2)	0.8		mA	$V_{CE} = 5.0$ V	$H = 20$ mW/cm²
$I_{CE(L)}$	Collector Light Current (See Note 3)	1.0		mA	$V_{CE} = 5.0$ V	$H = 9.0$ mW/cm²
$I_{CE(D)}$	Collector Dark Current		0.1	μA	$V_{CE} = 15$ V	$H \leqq 0.1$ μW/cm²
BV_{ECO}	Emitter-Collector Breakdown Voltage	5		Volts	$I_C = 0.1$ mA	$H \leqq 0.1$ μW/cm²

*Planar is a patented Fairchild process

NOTES:

(1) Derating factor is 0.6 mW/°C above 25°C. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(2) Irradiation source is an unfiltered tungsten lamp operated at 2870°K color temperature. Unless otherwise stated, all H values refer to this color temperature.
(3) Irradiation source is a filtered tungsten lamp with Corning CS7-69 filter, plus a 2 cm H_2O filter cell. This rejects wavelengths outside the 0.7 to 1.0 micron range of maxi response. This test method is included only for reference because of common usage. The unfiltered source is more typical of actual applications.
(4) Switching time is defined here as the 10% to 90% rise time of $I_{CE(L)}$ for an irradiance step input. The rise and fall times are essentially equal. See page 4 for the te circuit used for switching time measurements.
(5) Silicon radiometric photocurrent efficiency with typical GaAs irradiance is approximately three times greater than with tungsten at 2870°K color temperature. Therefore, a graphs with H as a parameter or variable will apply for GaAs irradiation if the H values are divided by three.

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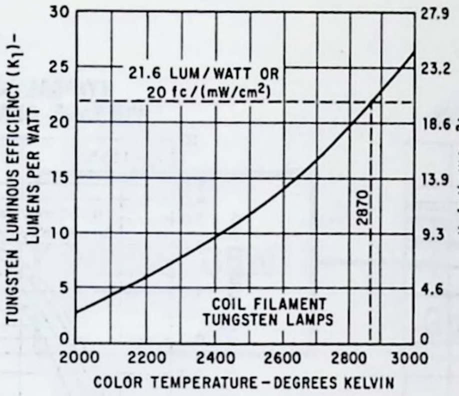
IRRADIATION AND ILLUMINATION

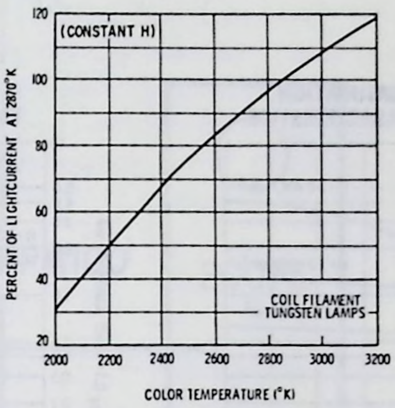
All irradiation levels are given in radiometric units (mW/cm²). Conversion to illumination units requires knowledge of luminous efficiency the of the source in lumens per watt of radiated power. For tungsten incandescent sources graph A may be used. Graph B shows the effect of tungsten color temperature upon light current for silicon sensors.

(GRAPH A)



$K_2 = 0.929 K_1$

(GRAPH B)



Ft. candles = candle power/distance in ft² = lumens/ft² = (mW/cm²) x 0.929 x lumens per watt.

DEFINITIONS

IRRADIANCE — Total incident radiant power. Measured in power per unit area. Symbol: H.

ILLUMINANCE — Incident irradiation of wavelengths that are visible to the human eye. Measured in ft. candles.

LUMINOUS EFFICIENCY — Ratio of illuminance to irradiance.

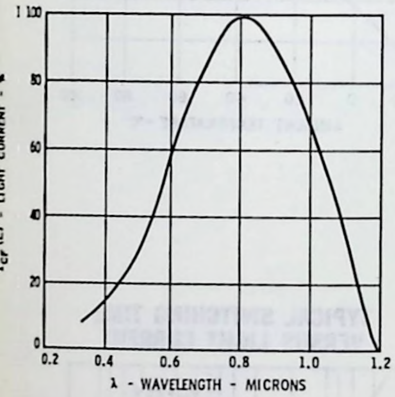
LIGHT CURRENT — The current resulting from the action of light upon a light sensitive device.

DARK CURRENT — Current in a photosensitive device that is effectively shielded from wavelengths to which it responds.

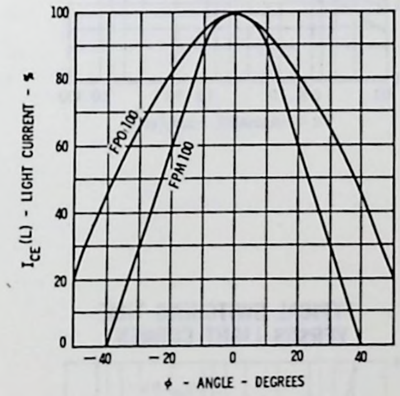
COLOR TEMPERATURE — The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

SPECTRAL IRRADIANCE — The radiant power within a specified wavelength interval that is incident on a surface. Measured in power per unit surface per unit wavelength.

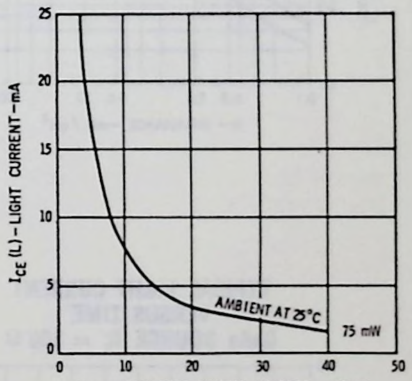
TYPICAL LIGHT CURRENT VERSUS WAVELENGTH WITH CONSTANT SPECTRAL IRRADIANCE



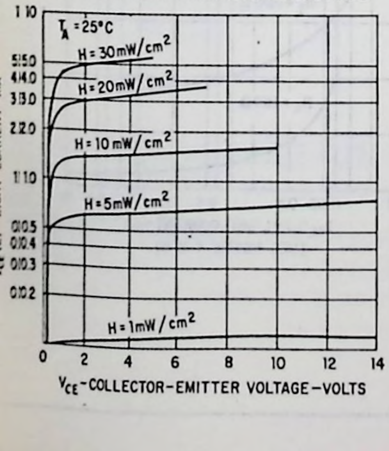
TYPICAL LIGHT CURRENT VERSUS ANGLE OF INCIDENT IRRADIATION



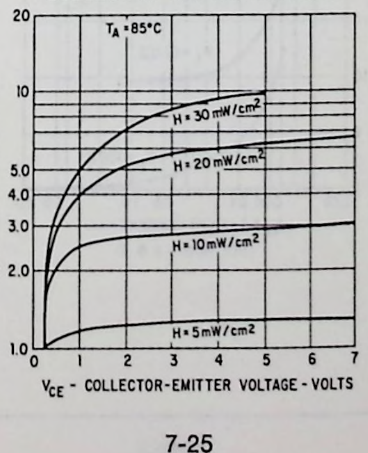
MAXIMUM POWER LIMITS



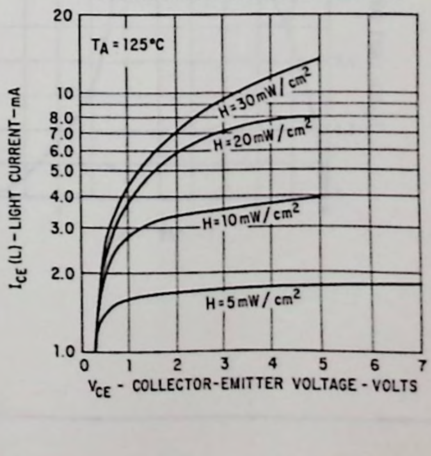
TYPICAL COLLECTOR CHARACTERISTICS



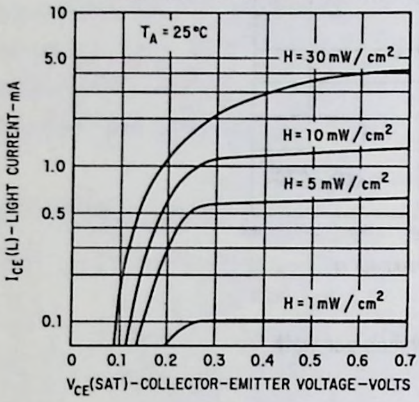
TYPICAL COLLECTOR CHARACTERISTICS



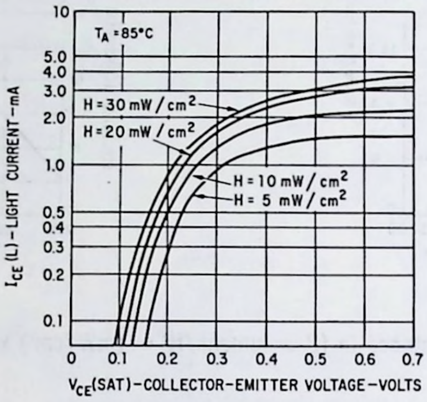
TYPICAL COLLECTOR CHARACTERISTICS



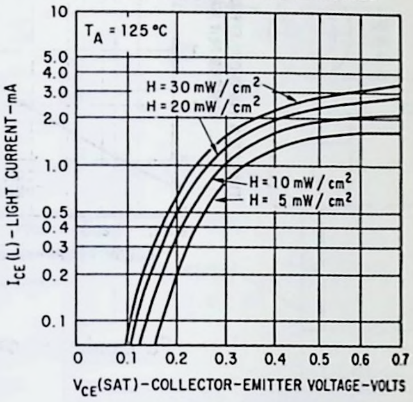
TYPICAL SATURATION VOLTAGE CHARACTERISTICS



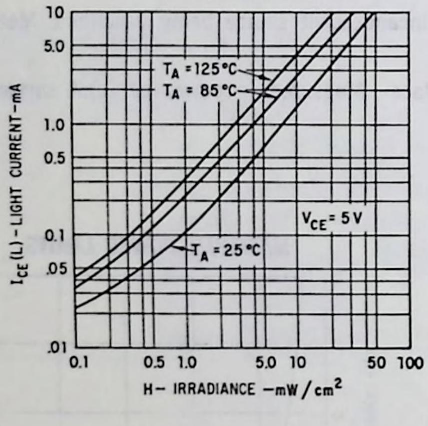
TYPICAL SATURATION VOLTAGE CHARACTERISTICS



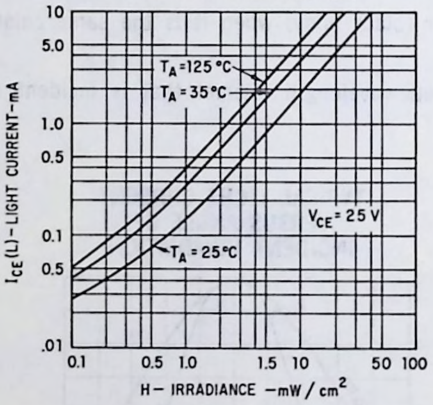
TYPICAL SATURATION VOLTAGE CHARACTERISTICS



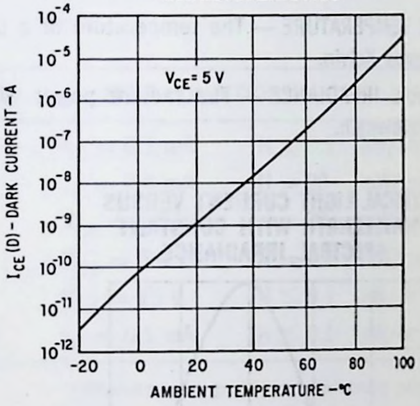
TYPICAL LIGHT CURRENT VERSUS IRRADIANCE



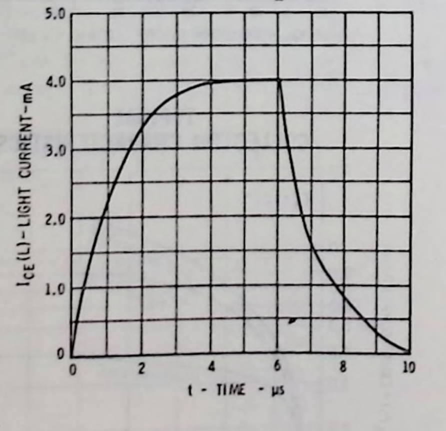
TYPICAL LIGHT CURRENT VERSUS IRRADIANCE



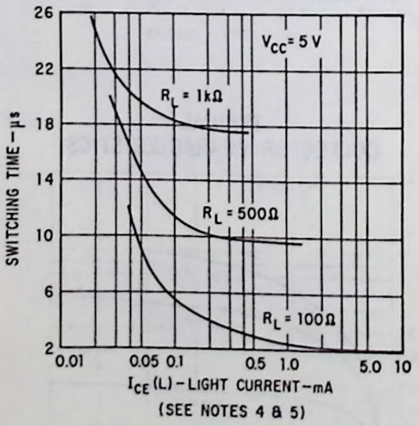
TYPICAL DARK CURRENT CHARACTERISTICS



TYPICAL LIGHT CURRENT VERSUS TIME GaAs SOURCE $R_L = 100\ \Omega$

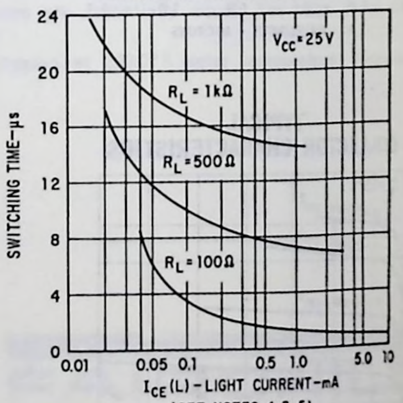


TYPICAL SWITCHING TIME VERSUS LIGHT CURRENT



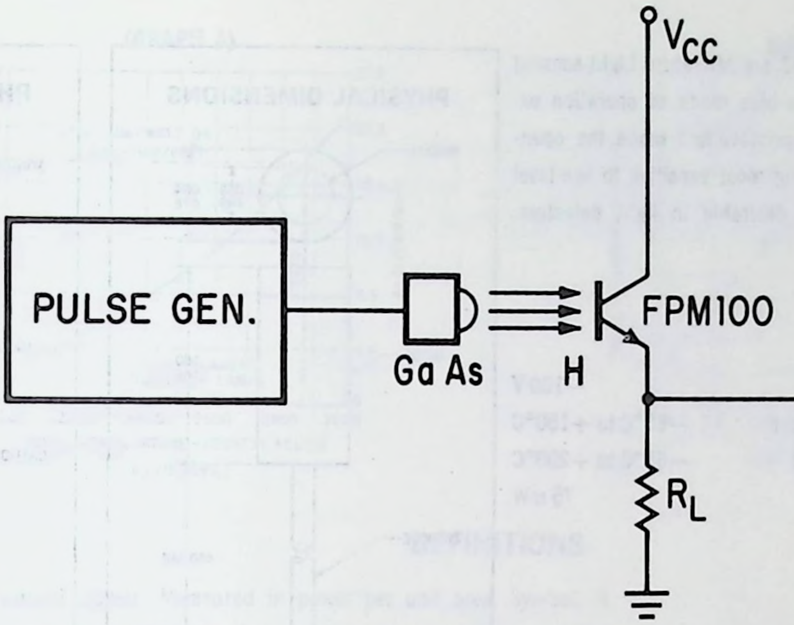
(SEE NOTES 4 & 5)

TYPICAL SWITCHING TIME VERSUS LIGHT CURRENT



(SEE NOTES 4 & 5)

SWITCHING TIME MEASUREMENT SETUP


V_{CC}
PULSE GEN.
Ga As
H
FPM100
SCOPE
R_L

FPM200 • FP0200

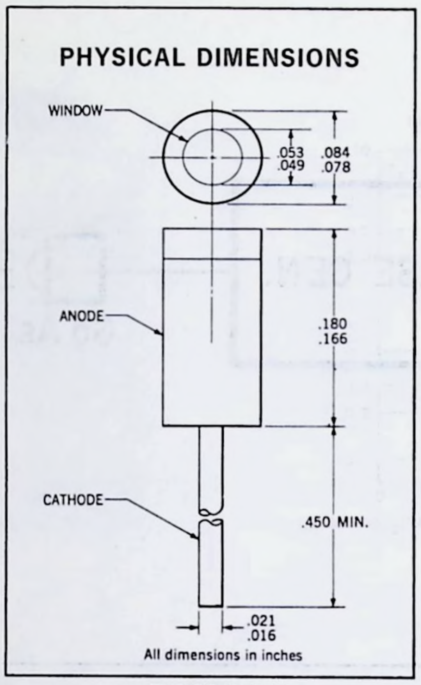
SILICON PLANAR* PASSIVATED PHOTODIODE

TWO TERMINAL COAXIAL PACKAGE

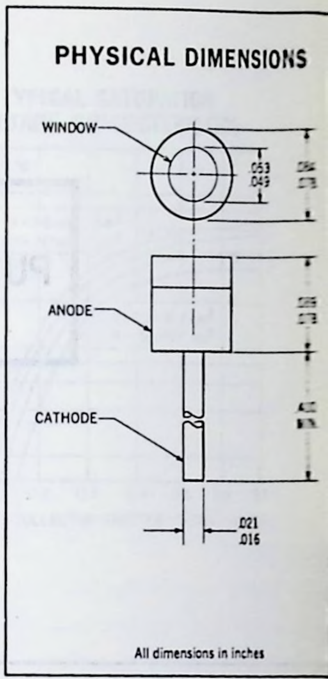
GENERAL DESCRIPTION — The FPM200 and FP0200 are Miniature Light-sensing Diodes in a hermetic, welded case. In the reverse-bias mode of operation excellent photocurrent linearity is obtained. In the photovoltaic mode the open-circuit voltage varies in a logarithmic manner, being most sensitive to low-level light variations. This type of response is often desirable in light detectors, curve followers, and other servo-type applications.

ABSOLUTE MAXIMUM RATINGS

V_R	Reverse Voltage	−100 V
T_A	Operating Temperature, Ambient	−65°C to +150°C
T_{stg}	Storage Temperature, Ambient	−65°C to +200°C
P	Power Dissipation 25°C Ambient (Note 1)	75 mW


PHYSICAL DIMENSIONS
WINDOW
.053
.049
.084
.078
ANODE
.180
.166
CATHODE
.450 MIN.
.021
.016
All dimensions in inches

FPM200


PHYSICAL DIMENSIONS
WINDOW
.053
.049
ANODE
CATHODE
.021
.016
All dimensions in inches

FP0200

ELECTRICAL CHARACTERISTICS (25°C) (Note 2)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS		
BV	Breakdown Voltage	−100		Volts	$I_R = 5\ \mu A$	$H \leqq 0.1$	μW/cm²
I_D	Dark Current		25	nA	$V_R = -10$ V	$H \leqq 0.1$	μW/cm²
V_{OC}	Open Circuit Voltage	380		mV	No bias	H = 20	mW/cm²
I_L	Light Current	13		μA	$V_R = -10$ V	H = 20	mW/cm²
I_{SC}	Short Circuit Current	13		μA	No bias	H = 20	mW/cm²
S	Sensitivity	0.65		μA/mW/cm²	No bias		

*Planar is a patented Fairchild proce

NOTES:

(1) Derating factor is 0.6 mW/°C above 25°C.

(2) Irradiation source is an unfiltered tungsten lamp operated at 2870°K color temperature.

FAIRCHILD
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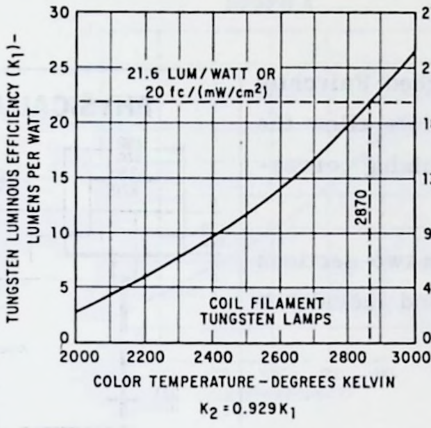
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

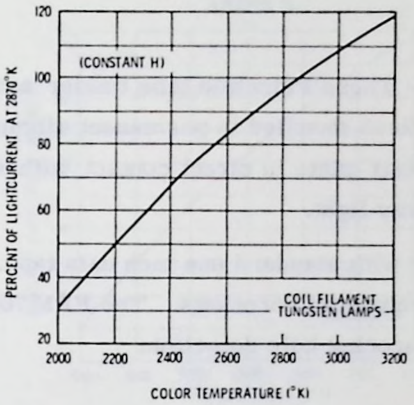
IRRADIATION AND ILLUMINATION

All light current ratings are given in radiometric dimensions (mW/cm²). Conversion to illumination units requires knowledge of the luminous efficiency of the source in lumens per watt of radiated power. For Tungsten incandescent sources graph A may be used. Graph B shows the effect of Tungsten color temperature upon light current for silicon sensors.

(GRAPH A)



(GRAPH B)



DEFINITIONS

IRRADIANCE — Total incident radiant power. Measured in power per unit area. Symbol: H.

ILLUMINANCE — Incident irradiation of wavelengths that are visible to the human eye. Measured in ft. candles.

LUMINOUS EFFICIENCY — Ratio of illuminance to irradiance.

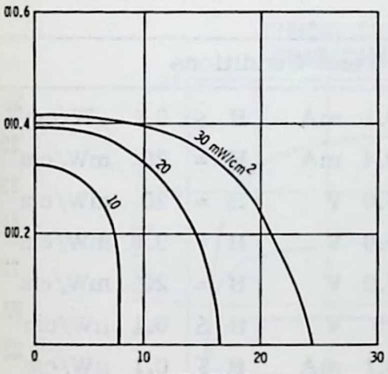
LIGHT CURRENT — The current resulting from the action of light upon a light sensitive device.

DARK CURRENT — Current in a photosensitive device that is effectively shielded from wavelengths to which it responds.

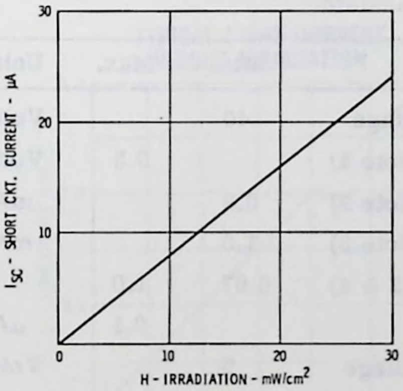
COLOR TEMPERATURE — The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

SPECTRAL IRRADIANCE — The radiant power within a specified wavelength interval that is incident on a surface. Measured in power per unit surface per unit wavelength.

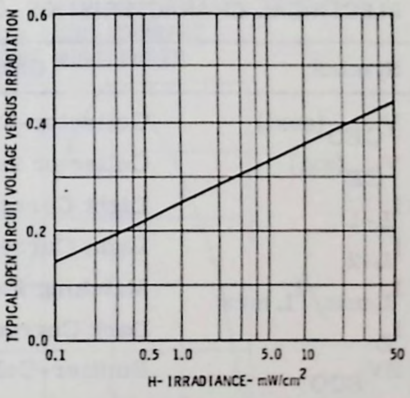
TYPICAL VOLTAGE VERSUS CURRENT CHARACTERISTIC



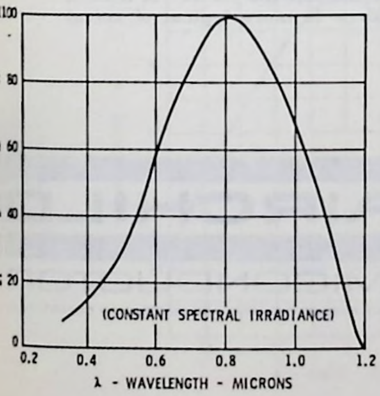
TYPICAL SHORT CIRCUIT CURRENT VERSUS IRRADIATION



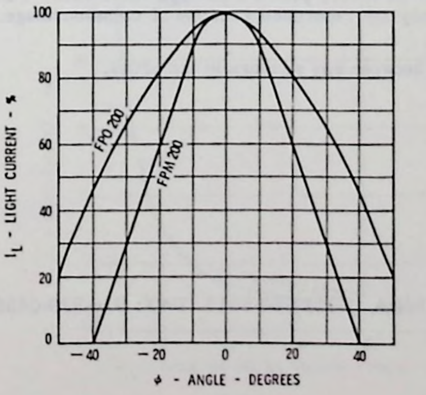
TYPICAL OPEN CIRCUIT VOLTAGE VERSUS IRRADIATION



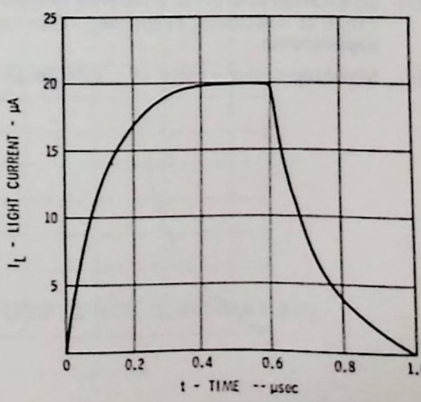
TYPICAL LIGHT CURRENT VERSUS WAVELENGTH



TYPICAL LIGHT CURRENT VERSUS ANGLE OF INCIDENT IRRADIATION



TYPICAL LIGHT CURRENT VERSUS TIME GaAs SOURCE $R_L = 100\ \Omega$



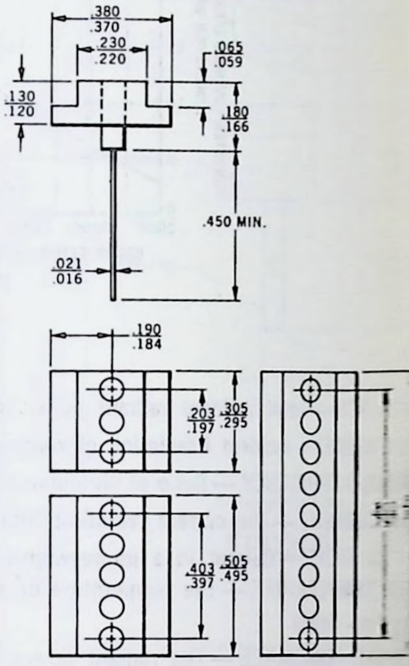
FPM 7011 • FPM 7012

NPN PHOTOTRANSISTOR TAPE READER ARRAYS

GENERAL DESCRIPTION - These Fairchild tape reader arrays consist of matched Fairchild FPM100 phototransistors flush mounted in permanent alignment. The flat windows allow the front surface to serve as wear-plate in direct contact with data tape thus minimizing cross-talk and the influence of stray light.

Dimensions are compatible with standard one inch data tape. The FPM 7011 is in two sections to accommodate in-line mechanical sprockets. The FPM 7012 is in one piece and includes a ninth phototransistor for sprocket hole detection.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches.
Brass plate is common to all emitters.
All holes on 0.100 ± .002 centers.
Windows are nominal .051 diameter

ABSOLUTE MAXIMUM RATINGS (Each Phototransistor)

V_{CE}	Collector-Emitter Voltage		40 V
V_{EC}	Emitter-Collector Voltage		5 V
P	Power Dissipation (25°C Ambient)	(Note 1)	75 mW
T_A	Operating Temperature, Ambient		-65°C to +175°C
T_{stg}	Storage Temperature, Ambient		-65°C to +200°C

ELECTRICAL CHARACTERISTICS (25°C Each Phototransistor

Symbol	Characteristic		Min.	Max.	Units	Test Conditions	
V_{CEO}(sust)	Collector-Emitter Sustaining Voltage		40		Volts	I_C = 0.1 mA	H ≤ 0.1 μW/c
V_{CE}(sat)	Collector Saturation Voltage	(Note 2)		0.3	Volts	I_C = 0.4 mA	H = 20 mW/c
I_{L-1}	Light Current	(Note 2)	0.8		mA	V_{CE} = 5.0 V	H = 20 mW/c
I_{L-2}	Light Current	(Note 3)	1.0		mA	V_{CE} = 5.0 V	H = 9.0 mW/c
$I_{L\,min}/I_{L\,max}$	Matching Factor	(Note 2 & 4)	0.67	1.0		V_{CE} = 5.0 V	H = 20 mW/c
I_D	Dark Current			0.1	μA	V_{CE} = 15 V	H ≤ 0.1 μW/c
BV_{ECO}	Emitter-Collector Breakdown Voltage		5		Volts	I_C = 0.1 mA	H ≤ 0.1 μW/c

NOTES:

(1) Derating factor is 0.5 mW/°C above 25°C.

(2) Irradiation source is an unfiltered tungsten lamp at 2870°K color temperature.

(3) Irradiation source is a filtered tungsten lamp with Corning CS7-69 filter, plus a 2 cm H_2O filter cell. This rejects wavelengths outside the 0.7 to 1.0 micron range of maximum response. This test method is included only for reference because of common usage. The unfiltered source is more typical of actual applications.

(4) Matching factor = ratio of minimum to maximum light current between any sensors in the array.

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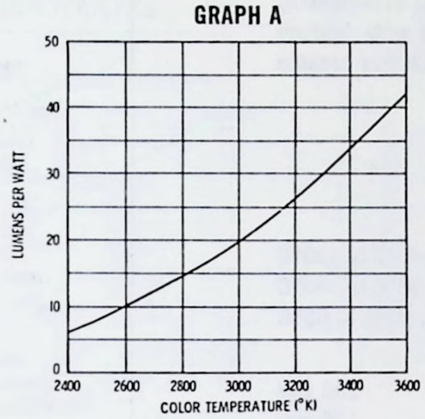
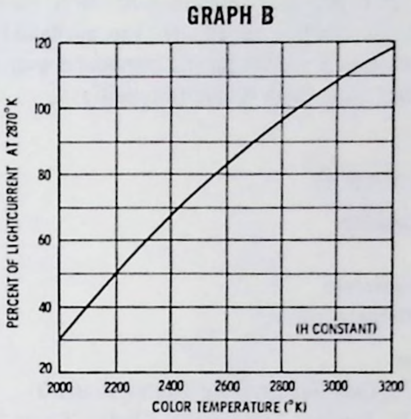
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

IRRADIATION AND ILLUMINATION

All light current ratings are given in radiometric dimensions (mW/cm^2). Conversion to illumination units requires knowledge of the luminous efficiency of the source in lumens per watt of radiated power. For incandescent sources graph A may be used. Graph B shows the effect of color temperature upon light current.

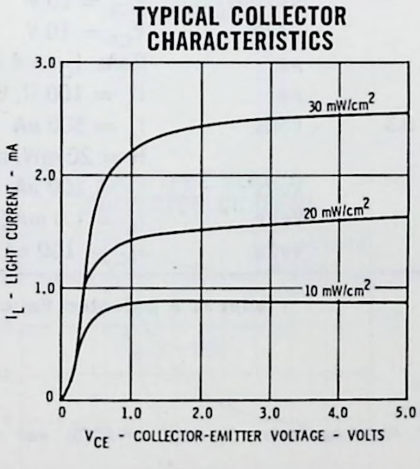

GRAPH A

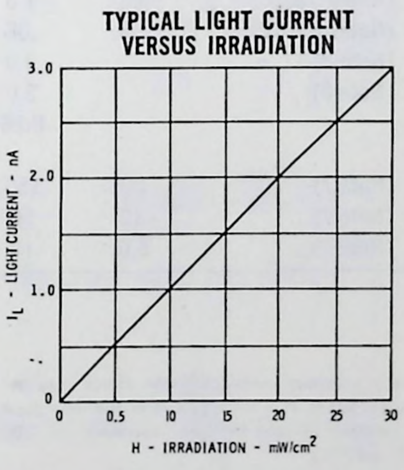

GRAPH B

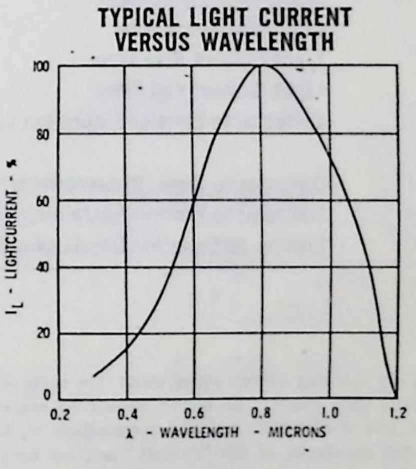
Ft. candles = candle power/distance in ft^2 = lumens/ft^2 = mW/cm^2 x 0.929 x lumens per watt

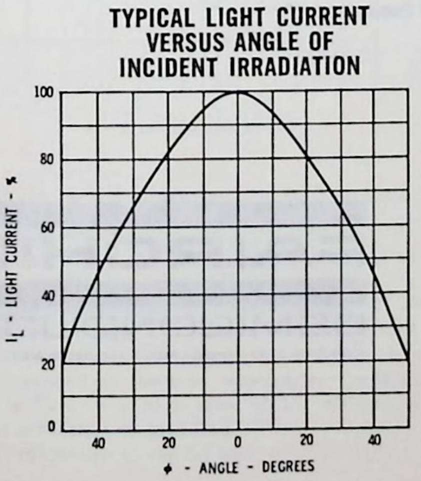
DEFINITIONS

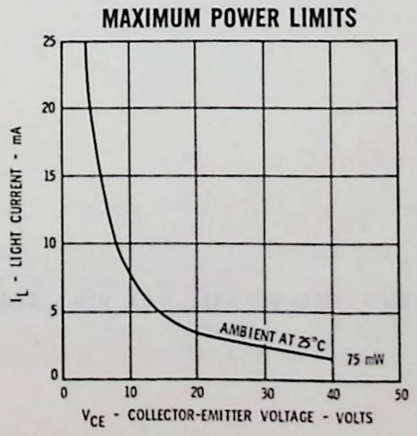
IRRADIATION:	Total incident radiant energy. Measured in power per unit area. Symbol: H
ILLUMINATION:	Incident irradiation of wavelengths which are visible to the human eye. Measured in ft. candles.
LUMINOUS EFFICIENCY:	Ratio of illumination to irradiation.
LIGHT CURRENT:	The current resulting from the action of light upon a light sensitive device.
DARK CURRENT:	Current in a photosensitive device which is effectively shielded from wavelengths to which it responds.
COLOR TEMPERATURE:	The temperature of a perfect radiator (black body) when it is the same color as the incandescent source being described. Measured in degrees Kelvin.

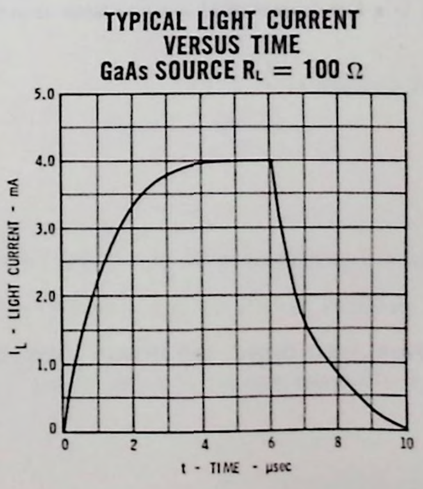

TYPICAL COLLECTOR CHARACTERISTICS


TYPICAL LIGHT CURRENT VERSUS IRRADIATION


TYPICAL LIGHT CURRENT VERSUS WAVELENGTH


TYPICAL LIGHT CURRENT VERSUS ANGLE OF INCIDENT IRRADIATION


MAXIMUM POWER LIMITS

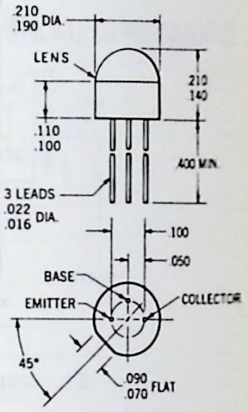

TYPICAL LIGHT CURRENT VERSUS TIME GaAs SOURCE $R_L = 100\ \Omega$

FPT100

NPN PLANAR* PHOTOTRANSISTOR

GENERAL DESCRIPTION — The FPT 100 is a three-terminal NPN Planar phototransistor having exceptionally stable characteristics and high illumination sensitivity. The availability of the base lead gives wide latitude for flexible circuit design. The case is a special plastic compound with transparent resin encapsulation capable of exhibiting stable characteristics under high humidity conditions.

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
All leads electrically isolated from case

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures/Humidity	
Storage Temperature	−40°C to 100°C
Operating Junction Temperature	−40°C to 85°C
Relative Humidity @ Temperature	95% at 65°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	200 mW
at 25°C Ambient Temperature (Notes 2 and 3)	100 mW
Maximum Voltages (Note 7)	
V_{CBO} Collector to Base Voltage	80 Volts
V_{CEO} Collector to Emitter Sustaining Voltage (Note 4)	30 Volts
V_{EBO} Emitter to Collector Voltage	5.0 Volts
Maximum Current	
I_C Collector Current	25 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
I_{CBO}	Collector Dark Current	(Note 7)		0.25	25	nA	$V_{CB} = 10$ V
I_{CBO}(65°C)	Collector Dark Current	(Note 7)		0.025	0.5	μA	$V_{CB} = 10$ V
I_{CEO}	Collector Dark Current	(Note 7)		2.0	100	nA	$V_{CE} = 5.0$ V
RS_{CE}	Radiometric Sensitivity	(Notes 5 & 9)	40	280		μA/mW/cm²	$V_{CE} = 5.0$ V
LS_{CE}	Luminous Sensitivity	(Notes 6 & 9)	2.0	14		μA/fc	$V_{CE} = 5.0$ V
RS_{CB}	Radiometric Sensitivity	(Notes 5 & 10)	0.6	1.6		μA/mW/cm²	$V_{CB} = 10$ V
LS_{CB}	Luminous Sensitivity	(Notes 6 & 10)	.03	.08		μA/fc	$V_{CB} = 10$ V
t_r	Light Current Rise Time	(Note 8)		3.0		μs	GaAs, $I_C = 4.0$ mA
t_f	Light Current Fall Time	(Note 8)		3.0		μs	$R_L = 100\ \Omega$, $V_{CC} = 5.0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage			0.16	0.3	Volts	$I_C = 500\ \mu A$ $H = 20$ mW/cm²
BV_{CBO}	Collector to Base Breakdown Voltage	(Note 7)	80	150		Volts	$I_C = 100\ \mu A$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	(Note 7)	30	50		Volts	$I_C = 1.0$ mA (Pulsed)
BV_{ECO}	Emitter to Collector Breakdown Voltage	(Note 7)	5.0	10		Volts	$I_{EC} = 100\ \mu A$

*Planar is a patented Fairchild proce

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 85°C and junction to case thermal resistance of 300°C/Watt (derating factor of 3.33 mW/°C), and a junction ambient thermal resistance of 600°C/Watt (derating factor of 1.67 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

Notes continued on page 2

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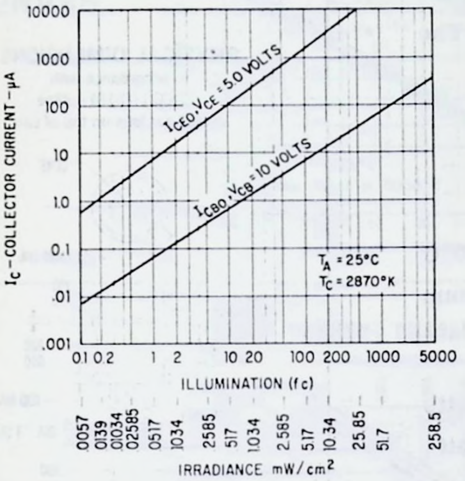
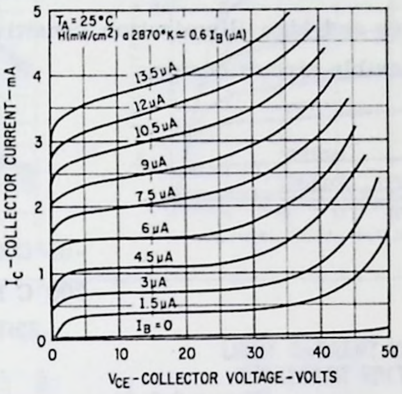
TYPICAL ELECTRICAL CHARACTERISTICS

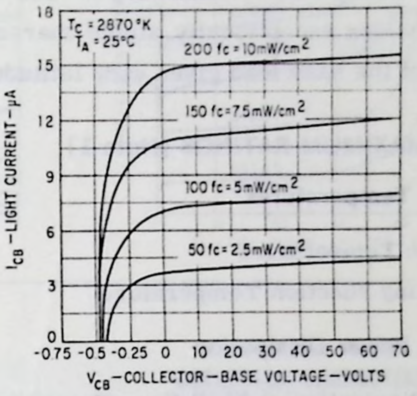
LIGHT CURRENT CHARACTERISTICS



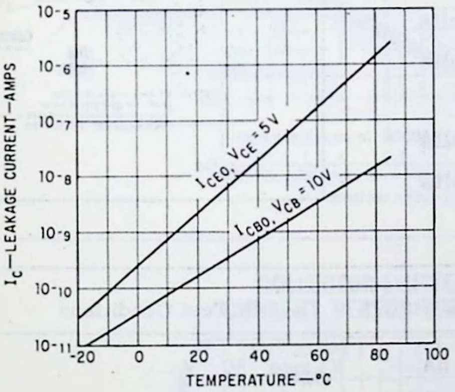
LIGHT CURRENT VERSUS COLLECTOR VOLTAGE*



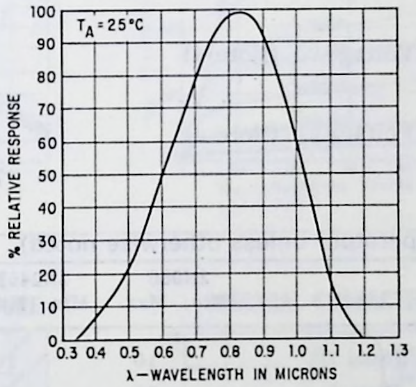
COLLECTOR BASE CHARACTERISTICS



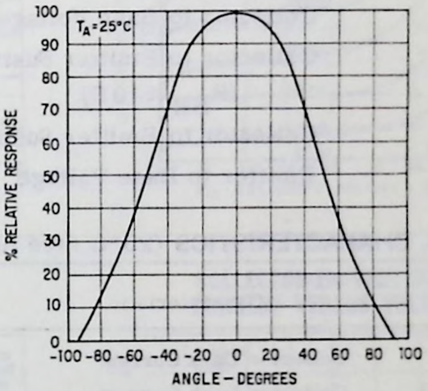
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



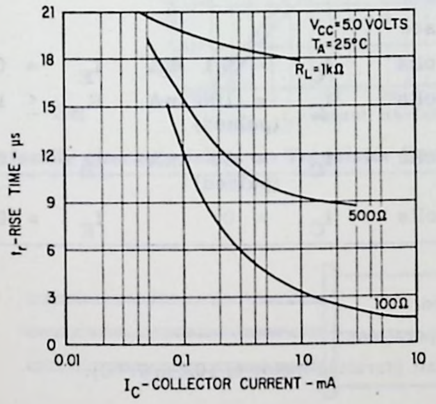
SPECTRAL CHARACTERISTICS



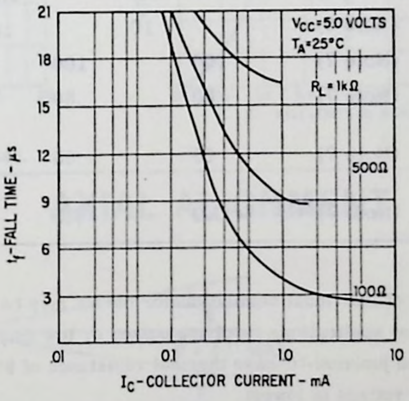
ANGULAR RESPONSE



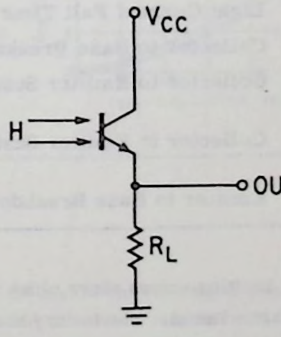
RISE TIME VERSUS COLLECTOR CURRENT



FALL TIME VERSUS COLLECTOR CURRENT



SWITCHING CIRCUIT



SOURCE – Ga As

* Single family characteristic on Transistor Curve Tracer.

OTES (continued):

5) Measured at radiation flux intensity of 5.0 mW/cm² as emitted from a tungsten filament lamp at a color temperature of 2870°K. The effective photosensitive area is typically 1.8 mm².

6) These are values obtained at an illumination level of 100 foot-candles from a tungsten filament lamp operated at a color temperature of 2870°K. All production tests are performed as stated in Note 5. For more information send for Fairchild Publication APP-47.

7) Measured with radiation flux intensity of less than .1 µW/cm² over the spectrum from 0.1 micron to 1.5 microns.

8) Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of a peak value of 1.0 milliampere. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of a peak value of 1.0 milliampere. For more information send for Fairchild Publication APP-93.

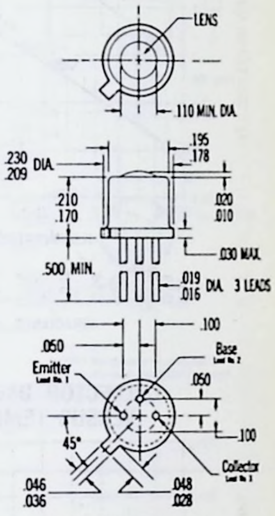
9) No electrical connection to base lead.

0) No electrical connection to emitter lead.

2N986 · 2N2452
NPN PLANAR PHOTOTRANSISTORS

GENERAL DESCRIPTION - The 2N986 and 2N2452 are three-terminal NPN Planar phototransistors having exceptionally stable characteristics and high illumination sensitivity. The availability of the base lead gives wide latitude for flexible circuit design.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline
except for lens on top of can



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.45 gram

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature		-65°C to +300°C
Operating Junction Temperature		200°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 & 3)	1.8 Watts
at 100°C Case Temperature	(Notes 2 & 3)	1.0 Watt
at 25°C Ambient Temperature		0.5 Watt

Maximum Voltages (Note 7)

V_{CBO}	Collector to Base Voltage		100 Volts
V_{CER}	Collector to Emitter Sustaining Voltage ($R_{BE} \leq 10\,\Omega$)	(Note 4)	80 Volts
V_{CEO}	Collector to Emitter Sustaining Voltage	(Note 4)	60 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

Symbol	Characteristic		2N986 Min.	2N986 Max.	2N2452 Min.	2N2452 Max.	Units	Test Conditions
I_{CBO}	Collector Dark Current	(Note 7)		10		10	nA	V_{CB} = 80 V
I_{CBO}(150°C)	Collector Dark Current	(Note 7)		25		25	μA	V_{CB} = 80 V
S_{CE}	Sensitivity Radiation System	(Notes 5 & 9)	20	60	50	200	μA/mW/cm^2	V_{CE} = 25 V
S_{CE}	Sensitivity Illumination System	(Notes 6 & 9)	1.0	3.1	2.6	10.3	μA/ft-can	V_{CE} = 25 V
S_{CB}	Sensitivity Radiation System	(Notes 5 & 10)	0.2	1.0	0.2	1.0	μA/mW/cm^2	V_{CB} = 25 V
S_{CB}	Sensitivity Illumination System	(Notes 6 & 10)	0.01	0.05	0.01	0.05	μA/ft-can	V_{CB} = 25 V
t_r	Light Current Rise Time	(Note 8)		1.0		1.0	μsec	
t_f	Light Current Fall Time	(Note 8)		10		10	μsec	
BV_{CBO}	Collector to Base Breakdown Voltage	(Note 7)	100		100		Volts	I_C = 0.1 mA I_E = 0
V_{CER}	Collector to Emitter Sustaining	(Note 7)	80		80		Volts	I_C = 100 mA (pulsed) $R_{BE} \leq 10$ Ω
V_{CEO}	Collector to Emitter Sustaining Voltage	(Note 7)	60		60		Volts	I_C = 30 mA (pulsed) I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	(Note 7)	7.0		7.0		Volts	I_C = 0 I_E = 0.1 m

NOTES:

(1) These ratings are limiting values above which the serviceability of individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 97.2°C/Watt (derating factor of 10.3 mW/°C).

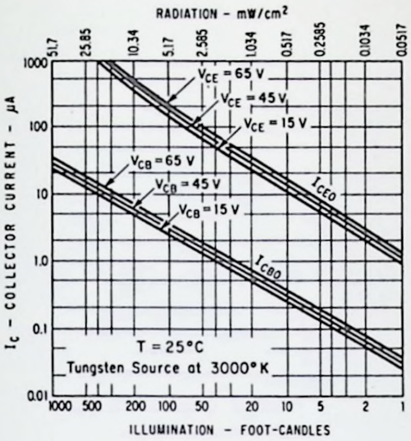
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest.

(NOTES CONTINUED ON PAGE

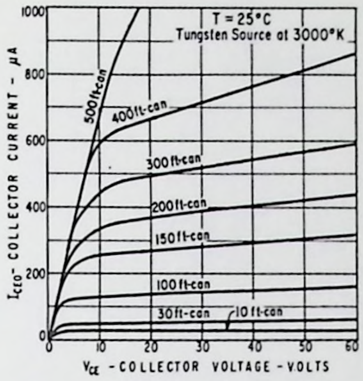
TYPICAL ELECTRICAL CHARACTERISTICS

2N986

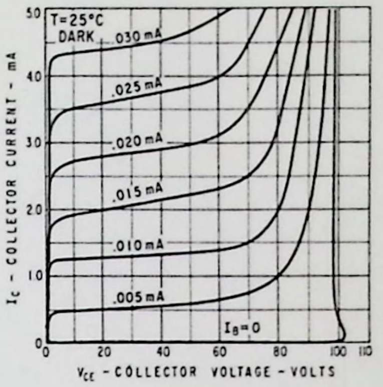
LIGHT CURRENT CHARACTERISTICS



LIGHT CURRENT VERSUS COLLECTOR VOLTAGE

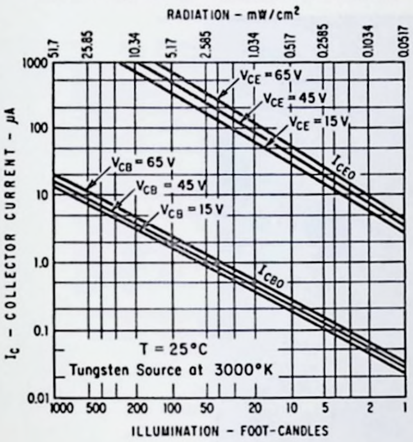


COLLECTOR CHARACTERISTICS*

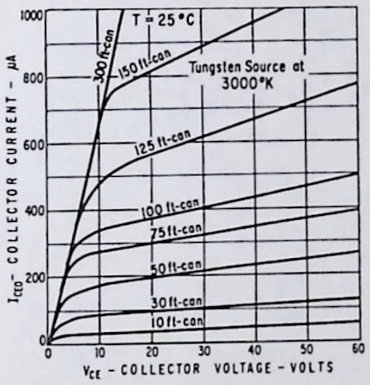


2N2452

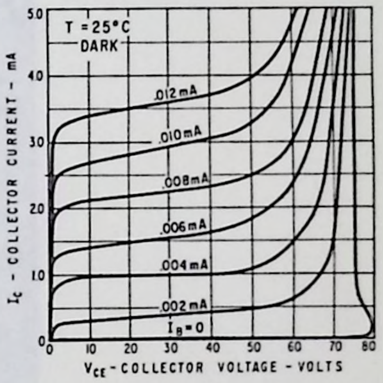
LIGHT CURRENT CHARACTERISTICS



LIGHT CURRENT VERSUS COLLECTOR VOLTAGE

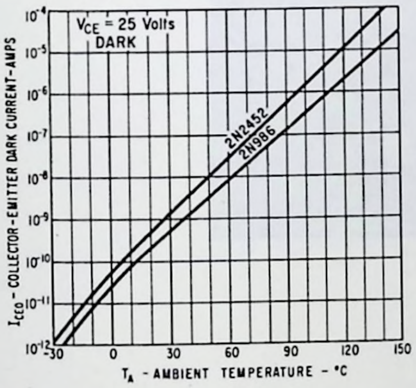


COLLECTOR CHARACTERISTICS*

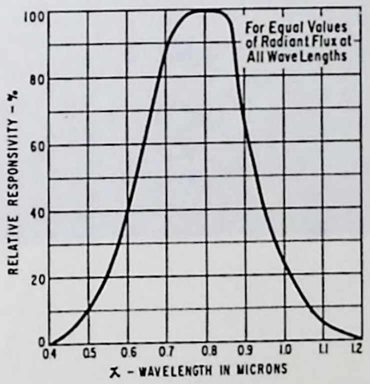


2N986
and
2N2452

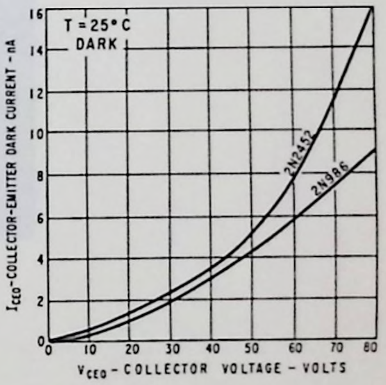
COLLECTOR-EMITTER DARK CURRENT VERSUS TEMPERATURE



SPECTRAL CHARACTERISTICS

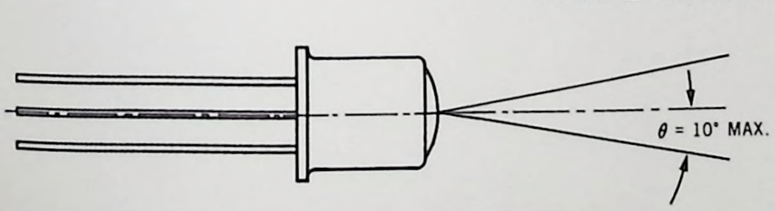


COLLECTOR-EMITTER DARK CURRENT VERSUS VOLTAGE



*Single family characteristics on Transistor Curve Tracer.

AXIAL ALIGNMENT



NOTE: The axis of maximum sensitivity shall be within a 10° cone with reference to the central axis of the device.

NOTES (continued)

Fairchild cannot assume responsibility for use of any circuitry described. No circuit patent licenses are implied.

Measured at radiation flux intensity of 5.0 mW/cm^2 as emitted from a tungsten filament lamp at a color temperature of 3000°K.

These are values obtained at an illumination level of 100 foot-candles from a tungsten filament lamp operated at a color temperature of 3000°K. All production tests are performed as stated in Note 5. For more information send for Fairchild Publication APP-47.

Measured with radiation flux intensity of less than 5 μW/cm^2 over the spectrum from 0.1 micron to 1.5 microns.

Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of a peak value of 1.0 milliampere. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of a peak value of 1.0 milliampere. For more information send for Fairchild Publication APP-93.

No electrical connection to base lead.

No electrical connection to emitter lead.

Power Transistors

PLANAR POWER

Fairchild has been producing Power Transistors since 1964, and has concentrated on the PLANAR epitaxial technology using discrete emitters and nickel-chromium thin film resistors. This effort has resulted in a line of premium devices that offer the user all the reliability and operating advantages of the PLANAR technology plus the increased power dissipation and safe operating area of discrete emitter devices.

Another benefit in designing with Fairchild's power transistors is the availability of complementary-designed pairs. These NPN-PNP pairs are now available in a variety of packages to a maximum rating of 10 Amperes, 100 Volts and 100 Watts dissipation.

PLANAR POWER ADVANTAGES

Reliability of a transistor depends on many factors. It is a mistake to consider a single factor, such as operating junction temperature, as the overall determinant of the transistor's reliability and life expectancy. There are at least two significant areas, usually neglected by the power transistor buyer, where Planar construction can add materially to the reliability of the device: 1. Long-term drift, and 2. Ambient influences.

LONG-TERM DRIFT AND STABILITY: Planar devices are inherently more stable and are affected less by long-term drift as a function of temperature and time. This is due to the passivated junctions of Planar transistors.

AMBIENT INFLUENCES: Reliability depends on the susceptibility of a given junction to ambient influences within the encapsulation. The passivation techniques used in the Planar process prohibit external influences from contaminating and degrading the junction surface.

Secondary Breakdown

Secondary breakdown frequently shows itself as localized spot heating which melts through the base region and causes a collector-to-emitter short. Take away the localized heating (or the concentration of currents which cause it) and you have removed the major cause of secondary breakdown. Fairchild does this by introducing nickel-chromium thin film resistors in series with the emitters. This prevents concentration of currents in any one spot. Here's how it works:

All power transistors can be represented mechanically as thousands of separate transistors placed in parallel. Theoretically, the same amount of current flows through each. But in reality, because each transistor has slightly different characteristics, one will draw more than its share of current. This causes localized heating, which in turn causes the transistor to "hog" yet more current, which causes more heating. If this unpleasant cycle continues unchecked, the result is secondary breakdown.

The NICR resistors, placed in series with the emitters, prevent this from happening. When a transistor tries to "hog" more than its share of current, the resistor induces a negative feedback which pulls it right back into the safe zone.

Thus, the key to solving secondary breakdown is not wider base areas, and/or lower frequencies. Fairchild power transistors, such as the 2N5002 and 2N5003, have the resistors deposited onto the chip, and assure current sharing over the entire emitter periphery. This technique is highly successful in preventing secondary breakdown, while maintaining high frequency and the superior performance of Planar technology.

PLANAR POWER TRANSISTOR COMPLEMENTARY PAIRS

Collector Current	Maximum Power Dissipation	Pkg.	Complementary Pair NPN — PNP
2 Amperes	6 Watts @ 50° Case	TO - 39	2N5148 — 2N5147
			2N5150 — 2N5149
	30 Watts @ 50° Case	TO - 59	2N4998 — 2N4999
			2N5000 — 2N5001
5 Amperes	10 Watts @ 50° Case	TO - 39	2N5152 — 2N5151
			2N5154 — 2N5153
	50 Watts @ 50° Case	TO - 59	2N5002 — 2N5003
			2N5004 — 2N5005
			2N5284 — 2N5286
			2N5285 — 2N5287
10 Amperes	100 Watts @ 50° Case	TO - 61	2N5006 — 2N5007
			2N5008 — 2N5009
			2N5288 — 2N5290
			2N5289 — 2N5291

PLANAR POWER SELECTION GUIDE

	Max. Power Dissipation @ T_C (W @ °C)	LV_{CEO} (V)	Min. h_{FE} @ I_C/V_{CE}	Package (*) = Isolated Collector	Fairchild Device Number
NPN 1 Amp	5 @ 25°	40	15 @ 1A/1V	TO - 5	2N4237
		60	15 @ 1A/1V	TO - 5	2N4238
		80	15 @ 1A/1V	TO - 5	2N4239
NPN 2 Amp	5 @ 25°	80	25 @ 2A/5V	TO - 5	2N2890
			40 @ 2A/5V	TO 5	2N2891
	6 @ 50°	80	15 @ 2A/5V	TO - 39	2N5148
			30 @ 2A/5V	TO - 39	2N5150
	30 @ 25°	80	25 @ 2A/5V	TO - 59	2N2892
				TO - 59*	2N4075
			40 @ 2A/5V	TO - 59	2N2893
				TO - 59*	2N4076
	30 @ 50°	80	15 @ 2A/5V	TO - 59*	2N4998
			30 @ 2A/5V	TO - 59*	2N5000
NPN 5 Amp	4 @ 100°	50	15 @ 5A/6V	TO - 5	2N2657
			40 @ 2A/2V	TO - 39	2N4895
			100 @ 2A/2V	TO - 39	2N4896
		70	15 @ 5A/6V	TO - 5	2N2658
		80	40 @ 2A/2V	TO - 39	2N4897
	10 @ 50°	80	20 @ 5A/5V	TO - 39	2N5152
			40 @ 5A/5V	TO - 39	2N5154
	32.5 @ 70° DARLINGTON	60	50 @ 5A/2.5V	TO - 9*	2N5425
			1000 @ 5A/1.5V	TO - 9*	2N5426
	37 @ 100°	80	20 @ 5A/5V	TO - 59*	2N4115
			40 @ 5A/5V	TO - 59*	2N4116
	50 @ 50°	80	20 @ 5A/5V	TO - 59*	2N5002
			40 @ 5A/5V	TO - 59*	2N5004
		100	20 @ 5A/5V	TO - 59*	2N5284
			40 @ 5A/5V	TO - 59*	2N5285
NPN 7 Amp	87 @ 25°	180	30 @ 1A/5V	TO - 3	2N5264
NPN 7.5 Amp	50 @ 100°	80	20 @ 2A/15V	TO - 61	2N1724
				TO - 61*	FT1724
			50 @ 2A/15V	TO - 61	2N1725
				TO - 61*	FT1725
NPN 10 Amp	20 @ 100°	60	40 @ 2A/2V	TO - 59*	2N5083
			100 @ 2A/2V	TO - 59*	2N5084
		80	40 @ 2A/2V	TO - 59*	2N5085
	100 @ 50°	80	20 @ 10A/5V	TO - 61*	2N5006
			45 @ 10A/5V	TO - 61*	2N5008
		100	20 @ 10A/5V	TO - 61*	2N5288
			45 @ 10A/5V	TO - 61*	2N5289
PNP 2 Amp	6 @ 50°	80	15 @ 2A/5V	TO - 39	2N5147
			30 @ 2A/5V	TO - 39	2N5149
	30 @ 50°	80	15 @ 2A/5V	TO - 59*	2N4999
			30 @ 2A/5V	TO - 59*	2N5001
PNP 5 Amp	10 @ 50°	80	20 @ 5A/5V	TO - 39	2N5151
			40 @ 5A/5V	TO - 39	2N5153
	50 @ 50°	80	20 @ 5A/5V	TO - 59*	2N5003
			40 @ 5A/5V	TO - 59*	2N5005
		100	20 @ 5A/5V	TO - 59*	2N5286
			40 @ 5A/5V	TO - 59*	2N5287
PNP 10 Amp	100 @ 50°	80	20 @ 10A/5V	TO - 61*	2N5007
			45 @ 10A/5V	TO - 61*	2N5009
		100	20 @ 10A/5V	TO - 61*	2N5290
			45 @ 10A/5V	TO - 61*	2N5291

FAIRCHILD SUGGESTED EQUIVALENTS

This cross-reference list is intended as a guide only. In some instances there will be package, thermal resistance, and safe area differences. The nearest electrical equivalent was selected on the basis of P_D, V_{CEO}, h_{FE} and $V_{CE(sat)}$.

Please refer to individual device specifications for additional information.

E.I.A. No.	Package	FSC No.
2N389	TO - 53	2N5006
2N389A	TO - 53	2N5006
2N424	TO - 53	2N5006
2N424A	TO - 53	2N5006
2N1047	Note 1	2N5002
2N1047A	Note 1	2N5002
2N1047B	Note 1	2N5002
2N1047C	Note 1	2N5002
2N1048	Note 1	2N5002
2N1048A	Note 1	2N5002
2N1048B	Note 1	2N5002
2N1048C	Note 1	2N5002
2N1049	Note 1	2N5002
2N1049A	Note 1	2N5002
2N1049B	Note 1	2N5002
2N1049C	Note 1	2N5002
2N1050	Note 1	2N5002
2N1050A	Note 1	2N5002
2N1050B	Note 1	2N5002
2N1050C	Note 1	2N5002
2N1079	TO - 53	2N1724
2N1080	TO - 53	2N1724
2N1208	TO - 61	2N5002
2N1209	TO - 61	2N5002
2N1210	TO - 53	2N5002
2N1211	TO - 53	2N5002
2N1212	TO - 61	2N5002
2N1511	TO - 36	2N5006
2N1512	TO - 36	2N5006
2N1513	TO - 36	2N5006
2N1514	TO - 36	2N5006
2N1616	TO - 61	2N5006
2N1616A	TO - 61	2N5006
2N1617	TO - 61	2N5006
2N1617A	TO - 61	2N5006
2N1618	TO - 61	2N5006
2N1618A	TO - 61	2N5006
2N1620	TO - 53	2N5006
2N1647	Note 2	2N5000
2N1648	Note 2	2N5000
2N1649	Note 2	2N5000
2N1650	Note 2	2N5000
2N1690	Note 3	2N5002
2N1691	Note 3	2N5002
2N1703	TO - 36	2N5006
2N1722	TO - 53	2N5006
2N1722A	TO - 53	2N5006
2N1723	TO - 53	2N5008
2N1724	TO - 61	2N1724
2N1724A	TO - 61	2N5006
2N1725	TO - 61	2N1725
2N1768	Note 3	2N5004
2N1769	Note 3	2N5004
2N2032	TO - 53	2N5002
2N2033	TO - 5	2N4238
2N2101	TO - 61	2N5006
2N2102	TO - 5	2N4238
2N2102A	TO - 5	2N4238
2N2150	7⁄16″ Stud	2N5002
2N2151	7⁄16″ Stud	2N5002
2N2339	Note 3	2N5002
2N2383	TO - 36	2N5006
2N2384	TO - 61	2N5006
2N2594	TO - 5	2N4238
2N2632	TO - 62	2N5004
2N2633	TO - 62	2N5004
2N2634	TO - 62	2N5004
2N2657	TO - 5	2N2657
2N2658	TO - 5	2N2658
2N2697	Note 4	2N5002
2N2698	Note 4	2N5004
2N2811	TO - 61	2N5006
2N2812	TO - 61	2N5008
2N2813	TO - 61	2N5006
2N2814	TO - 61	2N5008
2N2828	TO - 59	2N5002
2N2829	TO - 59	2N5004
2N2849-1	TO - 5	2N5154
2N2849-2	7⁄16″ Stud	2N5000
2N2849-3	Note 4	2N5000
2N2850-1	TO - 5	2N5154
2N2850-2	7⁄16″ Stud	2N5000
2N2850-3	Note 4	2N5000
2N2851-1	TO - 5	2N5154
2N2851-2	7⁄16″ Stud	2N5000
2N2851-3	Note 4	2N5000
2N2852-1	TO - 5	2N5154
2N2852-2	7⁄16″ Stud	2N5000
2N2852-3	Note 4	2N5000
2N2853-1	TO - 5	2N5152
2N2854-1	TO - 5	2N5154
2N2854-2	7⁄16″ Stud	2N5000
2N2854-3	Note 4	2N5000
2N2855-1	TO - 5	2N5154
2N2855-2	7⁄16″ Stud	2N5000
2N2855-3	Note 4	2N5000
2N2856-1	TO - 5	2N5152
2N2866	7⁄16″ Stud	2N5002
2N2867	7⁄16″ Stud	2N5004
2N2877	TO - 59	2N5002
2N2878	TO - 59	2N5002
2N2879	TO - 59	2N5002
2N2880	TO - 59	2N5002
2N2887	TO - 61	2N5000
2N2890	TO - 5	2N5150
2N2891	TO - 5	2N5150
2N2892	TO - 59	2N5000
2N2893	TO - 59	2N5000
2N2983	TO - 5	2N4239
2N2984	TO - 5	2N4239
2N2985	TO - 5	2N4239
2N2986	TO - 5	2N4239
2N2987	TO - 5	2N4239
2N2988	TO - 5	2N4239
2N2989	TO - 5	2N4239
2N2990	TO - 5	2N4239
2N2991	Note 4	2N5000
2N2992	Note 4	2N5000
2N2993	Note 4	2N5000
2N2994	Note 4	2N5000
2N2995	Note 4	2N5000
2N3163	TO - 61	2N5007
2N3164	TO - 61	2N5007
2N3165	TO - 61	2N5007
2N3166	TO - 61	2N5007
2N3167	TO - 53	2N5007
2N3168	TO - 53	2N5007
2N3169	TO - 53	2N5007
2N3170	TO - 53	2N5007
2N3175	TO - 61	2N5007
2N3176	TO - 61	2N5007
2N3177	TO - 61	2N5007
2N3178	TO - 61	2N5007
2N3179	TO - 53	2N5007
2N3180	TO - 53	2N5007
2N3181	TO - 53	2N5007
2N3187	TO - 61	2N5007
2N3188	TO - 61	2N5007
2N3189	TO - 61	2N5007
2N3190	TO - 61	2N5007
2N3191	TO - 53	2N5007
2N3192	TO - 53	2N5007
2N3193	TO - 53	2N5007
2N3194	TO - 53	2N5007
2N3199	TO - 59	2N5003
2N3200	TO - 59	2N5003
2N3201	TO - 59	2N5003
2N3205	TO - 59	2N5003
2N3206	TO - 59	2N5003
2N3207	TO - 59	2N5003
2N3220	TO - 59	2N5150
2N3221	TO - 59	2N5150
2N3222	TO - 59	2N5150
2N3223	TO - 59	2N5150
2N3419	TO - 5	2N5148
2N3420	TO - 5	2N5150
2N3421	TO - 5	2N5150
2N3487	TO - 61	2N5006

FAIRCHILD SUGGESTED EQUIVALENTS

E.I.A. No.	Package	FSC No.	E.I.A. No.	Package	FSC No.	E.I.A. No.	Package	FSC N
2N3488	TO - 61	2N5006	2N3782	TO - 5	2N5147	2N4309	TO - 5	2N489
2N3489	TO - 61	2N5006	2N3795	TO - 5	2N5147	2N4311	TO - 5	2N489
2N3490	TO - 61	2N5008	2N3850	TO - 59	2N5000	2N4895	TO - 39	2N489
2N3491	TO - 61	2N5008	2N3851	TO - 59	2N5000	2N4896	TO - 39	2N489
2N3492	TO - 61	2N5008	2N3852	TO - 59	2N5000	2N5000	TO - 59	2N500
2N3551	Flat Pack	2N5008	2N3853	TO - 59	2N5000	2N5001	TO - 59	2N500
2N3552	Flat Pack	2N5008	2N3945	TO - 5	2N4238	2N5002	TO - 59	2N500
2N3597	TO - 63	2N5006	2N3996	TO - 59	2N5002	2N5003	TO - 59	2N500
2N3598	TO - 63	2N5006	2N3997	TO - 59	2N5002	2N5004	TO - 59	2N500
2N3599	TO - 63	2N5006	2N3998	TO - 59	2N5002	2N5005	TO - 59	2N500
2N3660	TO - 5	2N4237	2N3999	TO - 59	2N5002	2N5006	TO - 61	2N500
2N3661	TO - 5	2N4238	2N4036	TO - 5	2N5149	2N5007	TO - 61	2N500
2N3744	7/16" Stud	2N5002	2N4037	TO - 5	2N5149	2N5008	TO - 61	2N500
2N3745	7/16" Stud	2N5002	2N4075	TO - 59	2N4075	2N5009	TO - 61	2N500
2N3746	7/16" Stud	2N5002	2N4076	TO - 59	2N4076	2N5083	TO - 59	2N508
2N3747	7/16" Stud	2N5004	2N4115	TO - 59	2N4115	2N5084	TO - 59	2N508
2N3748	7/16" Stud	2N5004	2N4116	TO - 59	2N4116	2N5085	TO - 59	2N508
2N3749	7/16" Stud	2N5004	2N4150	TO - 5	2N4897	2N5147	TO - 39	2N514
2N3774	TO - 5	2N5147	2N4210	TO - 63	2N5006	2N5148	TO - 39	2N514
2N3775	TO - 5	2N5147	2N4211	TO - 63	2N5006	2N5149	TO - 39	2N514
2N3776	TO - 5	2N5147	2N4237	TO - 5	2N4237	2N5150	TO - 39	2N515
2N3777	TO - 5	2N5147	2N4238	TO - 5	2N4238	2N5151	TO - 39	2N515
2N3778	TO - 5	2N5147	2N4239	TO - 5	2N4239	2N5152	TO - 39	2N515
2N3779	TO - 5	2N5147	2N4301	TO - 61	2N5006	2N5153	TO - 39	2N515
2N3780	TO - 5	2N5147	2N4305	TO - 5	2N4897	2N5154	TO - 39	2N515
2N3781	TO - 5	2N5147	2N4307	TO - 5	2N4895			

Note 1. Small offset stud
2. 7/16" hex. stud mount 2 pin
3. Small offset stud
4. 7/16" hex. stud mount flexible leads

POWER TRANSISTOR NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
2N1724	8-1	2N5000	8-20	2N5150	8-50
2N2890	8-2	2N5001	8-24	2N5151	8-54
2N2891	8-2	2N5002	8-28	2N5158	8-58
2N2892	8-2	2N5003	8-32	2N5153	8-54
2N2893	8-2	2N5004	8-28	2N5154	8-58
2N4075	8-6	2N5005	8-32	2N5264	8-62
2N4076	8-6	2N5006	8-36	2N5284	8-64
2N4115	8-10	2N5007	8-40	2N5285	8-64
2N4116	8-10	2N5008	8-36	2N5286	8-66
2N4237	8-14	2N5009	8-40	2N5887	8-66
2N4238	8-14	2N5083	8-42	2N5288	8-68
2N4239	8-14	2N5084	8-42	2N5289	8-68
2N4895	8-16	2N5085	8-42	2N5290	8-70
2N4896	8-16	2N5147	8-46	2N5291	8-70
2N4897	8-16	2N5148	8-50	2N5425	8-72
2N4998	8-20	2N5149	8-46	2N5426	8-72
2N4999	8-24				

2N1724

NPN POWER TRANSISTOR

DIFFUSED SILICON PLANAR* TRANSISTOR

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N5006 • 2N5008

GENERAL DESCRIPTION

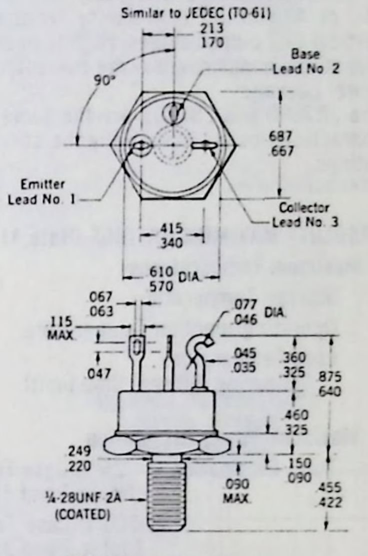
The Fairchild 2N1724 is a NPN silicon planar* transistor designed primarily for general purpose power applications.

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		+175°C
Maximum Power Dissipation [Notes 2 and 3]		
Collector Power Dissipation at 25°C Ambient Temperature		3.0 Watts
at 100°C Case Temperature		50 Watts
Maximum Voltage and Current		
V_{CBO}	Collector-Base Voltage	120 Volts
V_{EBO}	Emitter-Base Voltage	10 Volts
V_{CEO}	Collector-Emitter Voltage [Notes 4 and 6]	80 Volts
I_C	Collector Current (continuous)	5.0 Amps
I_E	Emitter Current	5.0 Amps
I_C	Collector Current (peak) [Note 5]	7.5 Amps

PHYSICAL DIMENSIONS

Similar to JEDEC (TO-61)



NOTES: All dimensions in inches
Package weight is 14.1 grams

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 6]	20	90		$I_C = 2.0$ A	$V_{CE} = 15$ V
h_{FE}	DC Pulse Current Gain [Note 6]	20			$I_C = 100$ mA	$V_{CE} = 15$ V
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 6]		1.0	Volt	$I_C = 2.0$ A	$I_B = 200$ mA
V_{BE} (sat)	Pulsed Base-Emitter Voltage [Note 6]		2.0	Volts	$I_C = 2.0$ A	$I_B = 200$ mA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Note 6]	80		Volts	$I_C = 200$ mA	$I_B = 0$
I_{CBO}	Collector Reverse Current		0.5	mA	$I_E = 0$	$V_{CB} = 3.0$ V
I_{CES}	Collector Reverse Current		1.0	mA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{CES} (150°C)	Collector Reverse Current		2.0	mA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{CES} (150°C)	Collector Reverse Current		10	mA	$V_{CE} = 120$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		10	mA	$I_C = 0$	$V_{EB} = 3.0$ V
I_{EBO}	Emitter Cutoff Current		10	mA	$I_C = 0$	$V_{EB} = 10$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 6]	12			$I_C = 2.0$ A	$V_{CE} = 15$ V
h_{fe}	Small Signal Current Gain (f = 10 MHz)	1.0			$I_C = 500$ mA	$V_{CE} = 15$ V
V_{EBF}	Emitter Floating Potential Voltage		10	Volts	$V_{CB} = 80$ V	
C_{obo}	Common Base Open Circuit Output Capacitance (f = 1.0 MHz)		550	pF	$I_E = 0$	$V_{CB} = 15$ V

* Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 1.5°C/Watt (derating factor of 667 mW/°C); junction to ambient thermal resistance of 50°C/Watt (derating factor of 20 mW/°C).
(4) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(5) Maximum peak collector current may be used if maximum junction temperature is not exceeded.
(6) Pulse Conditions: length = 300 μs; duty cycle = 2%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

2N2890 · 2N2891 · 2N2892 · 2N2893

NPN HIGH-POWER, HIGH-VOLTAGE TYPE

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — The 2N2892 and 2N2893 are 30-Watt* NPN silicon Planar epitaxial transistors designed for high-voltage, high-power amplifiers to 20 Mc; 12-, 24-, or 48-Volt DC converters; servo amplifiers; power supplies; and horizontal and vertical CRT output stages. High temperature operation is assured by the characteristic Planar low nanoamps leakage currents at high voltage. They are encased in a 7/16″ hex power package.

The 2N2890 and 2N2891 are the same devices in the popular TO-5 package. Electrical characteristics are essentially the same except for lower current and power dissipation ratings.

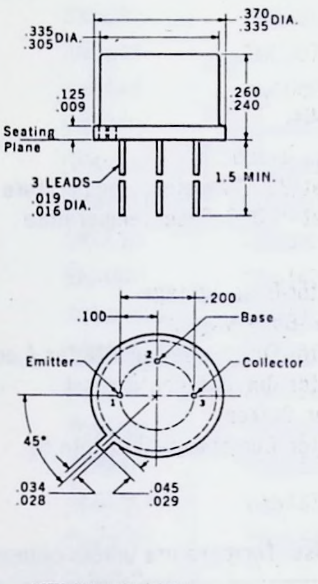
* See power curves.

ABSOLUTE MAXIMUM RATINGS [Note 1]

	2N2890 2N2891	2N2892 2N2893
Maximum Temperatures		
Storage Temperature	−65°C to +200°C	−65°C to +200°C
Operating Junction Temperature	200°C Maximum	200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)	300°C Maximum	300°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	5.0 Watts	30 Watts
at 100°C Case Temperature [Notes 2 and 3]	2.8 Watts	17 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.8 Watt	
Maximum Voltages		
V_{CBO} Collector to Base Voltage	100 Volts	100 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	80 Volts	80 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts	5.0 Volts

PHYSICAL DIMENSIONS

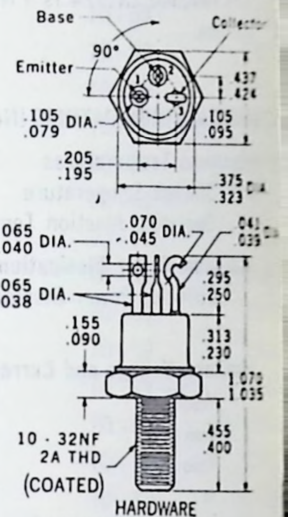
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 1.10 grams

2N2890 2N2891

PHYSICAL DIMENSIONS



HARDWARE

Flat nickel-plated brass washer
.205/.230 ID .475/.505 OD .040/.070 THICK
Flat mica washer (2)
.185/.205 ID .620/.630 OD .003/.008 THICK
Flat teflon spacer
.185/.205 ID .265/.280 OD .035/.055 THICK
Nickel plated brass hex nut
10-32 American Standard double chamfer

NOTES: All dimensions in inches
Collector internally connected to case
Package weight is 6.07 grams

2N2892 2N2893

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N2891 2N2893			2N2890 2N2892					
SYMBOL	CHARACTERISTIC	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	50	80	150	30	55	90		$I_C = 1.0$ A	$V_{CE} = 2.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	40	75		25	50			$I_C = 2.0$ A	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	35	80		20	55			$I_C = 100$ mA	$V_{CE} = 2.0$ V
V_{CE} (sat)	Collector Saturation Voltage (pulsed, Notes 5 and 6)		0.2	0.5		0.2	0.5	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
V_{CE} (sat)	Collector Saturation Voltage (pulsed, Notes 5 and 6)		0.35	0.75		0.35	0.75	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
V_{BE} (sat)	Base Saturation Voltage (pulsed, Notes 5 and 6)		1.0	1.2		1.0	1.2	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
V_{BE} (sat)	Base Saturation Voltage (pulsed, Notes 5 and 6)		1.1	1.3		1.1	1.3	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
I_{CEX}	Collector Cutoff Current		2.0	100		2.0	100	nA	$V_{CE} = 60$ V	$V_{BE} = -2.0$ V
I_{CEX} (150°C)	Collector Cutoff Current		7.0	100		7.0	100	μA	$V_{CE} = 60$ V	$V_{BE} = -2.0$ V
I_{CEO}	Collector Cutoff Current		1.0	50		1.0	50	μA	$I_B = 0$	$V_{CE} = 60$ V
h_{fe}	Small Signal Current Gain (f = 1 Kc)	50	90		30	65			$I_C = 50$ mA	$V_{CE} = 10$ V
h_{fe}	High Frequency Current Gain (f = 20 Mc)	1.5	2.5		1.5	2.3			$I_C = 200$ mA	$V_{CE} = 10$ V
C_{obo}	Common Base, Open Circuit Output Capacitance		38	70		38	70	pf	$I_E = 0$	$V_{CB} = 10$ V

Additional Electrical Characteristics on page 2

Notes on page 2

FAIRCHILD
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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted) (Continued)

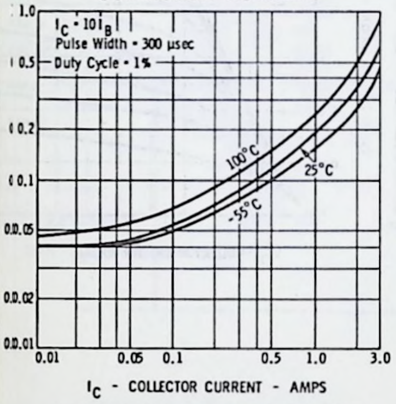
SYMBOL	CHARACTERISTIC	2N2891 2N2893 Min.	Typ.	Max.	2N2890 2N2892 Min.	Typ.	Max.	Units	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	100			100			Volts	$I_C = 100\ \mu A$ $I_E = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	80			80			Volts	$I_C = 100$ mA $I_B = 0$ (pulsed)
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_C = 0$ $I_E = 10\ \mu A$
t_{on}	Turn On Time [Note 7]			0.3			0.3	μsec	$I_C = 1.0$ A $I_{B1} \approx 50$ mA
t_{off}	Turn Off Time [Note 7]			1.5			1.5	μsec	$I_C = 1.0$ A, $I_{B1} = I_{B2} \approx 50$ mA

NOTES:

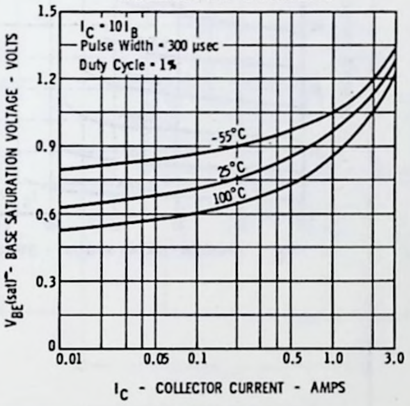
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C. For the 2N2890 and 2N2891 junction-to-case thermal resistance of 35°C/Watt (derating factor of 28.6 mW/°C); junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C). See power curves for 2N2892 and 2N2893 ratings.
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4.
(5) Pulse conditions: length = 300 μsec; duty cycle = 1%.
(6) Saturation voltages for 2N2890 and 2N2891 are measured with ¼" lead length.
(7) See switching circuit for exact I_{B1} and I_{B2} values.

TYPICAL ELECTRICAL CHARACTERISTICS

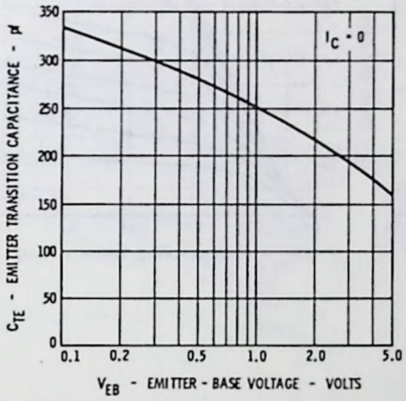
COLLECTOR SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



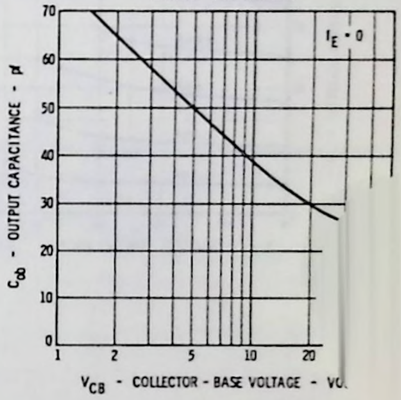
BASE SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



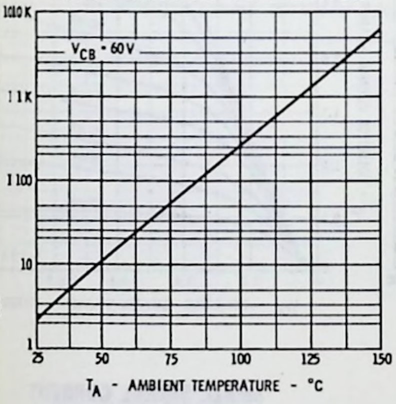
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



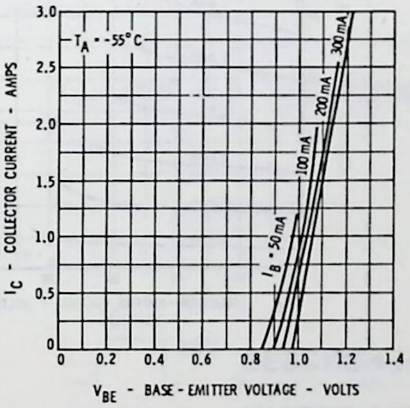
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



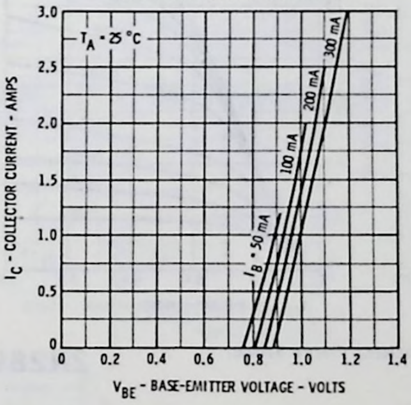
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



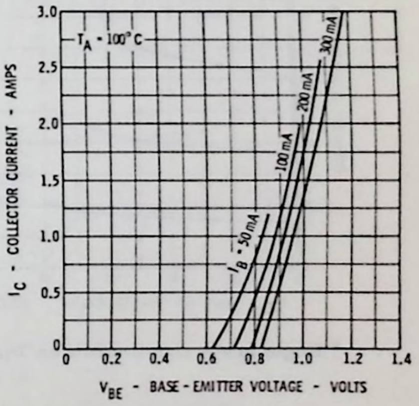
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



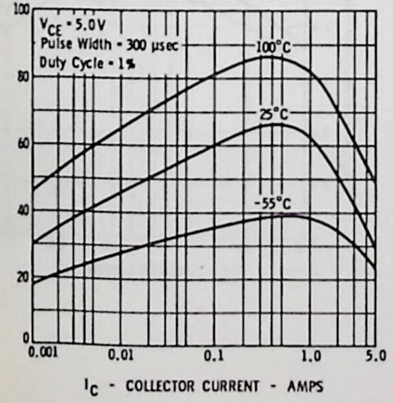
BASE CHARACTERISTICS*



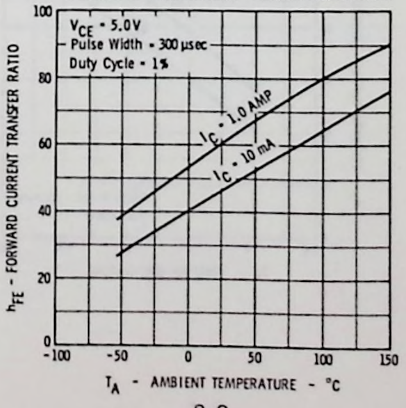
*Single family characteristic on Transistor Curve Tracer.

2N2890 • 2N2892

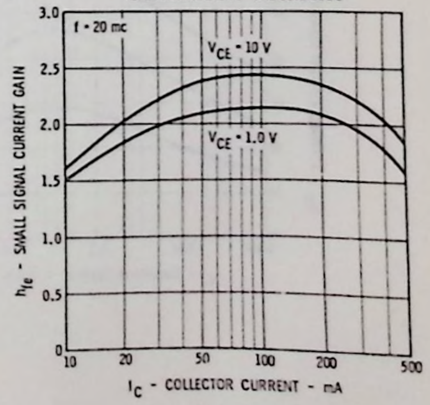
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



PULSED DC CURRENT GAIN VERSUS AMBIENT TEMPERATURE

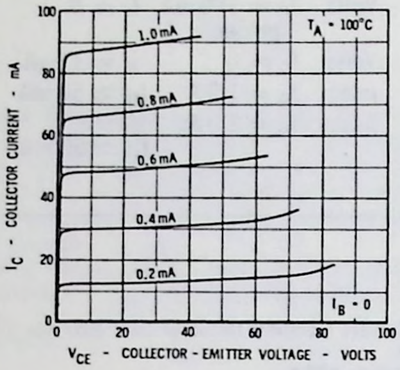


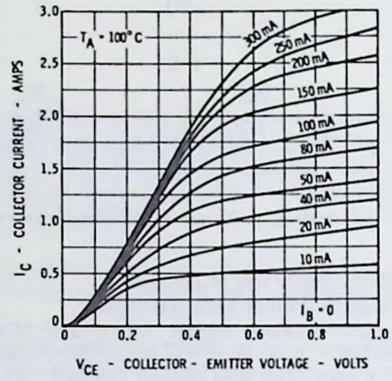
SMALL SIGNAL CURRENT GAIN AT 20 MC VERSUS COLLECTOR CURRENT



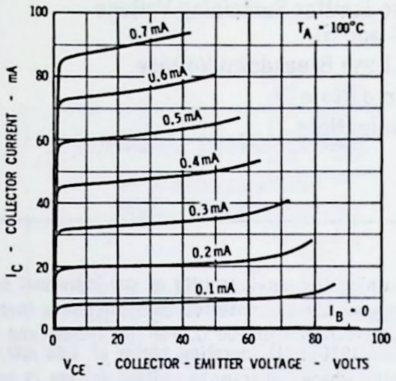
TYPICAL COLLECTOR CHARACTERISTICS*

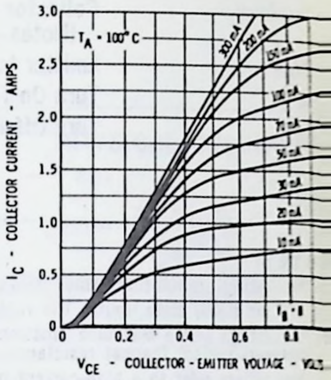
2N2890 • 2N2892

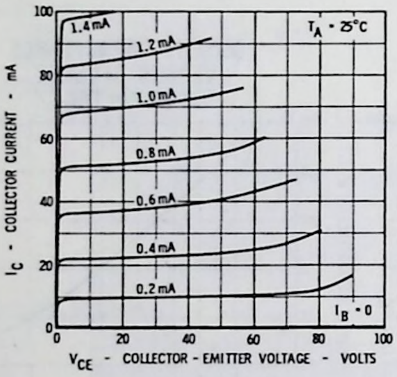


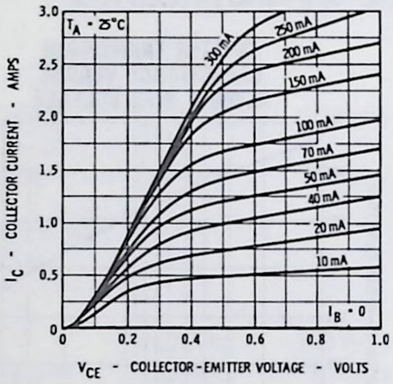


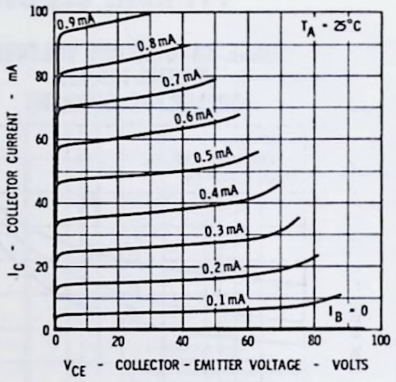
2N2891 • 2N2893

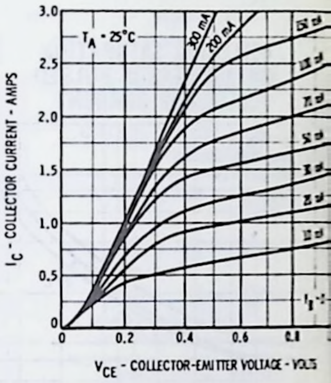


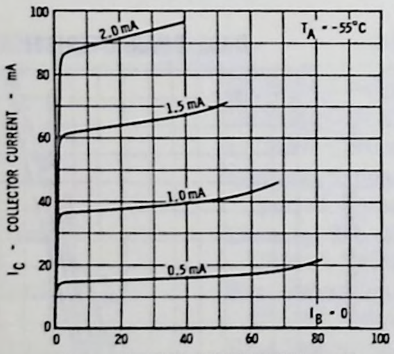


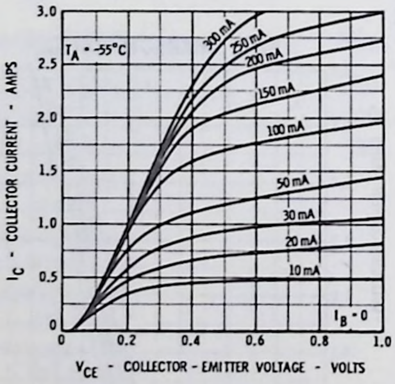


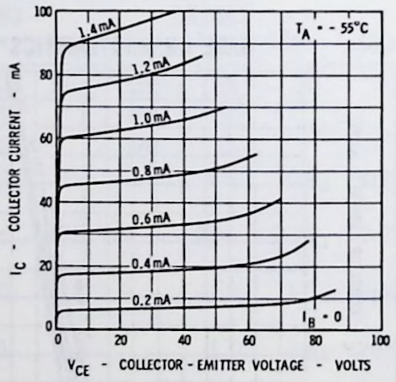


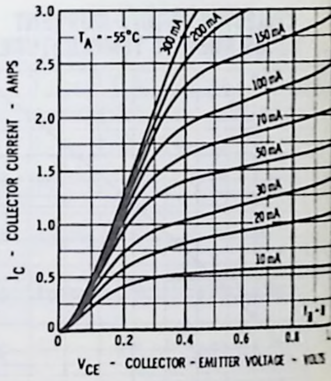








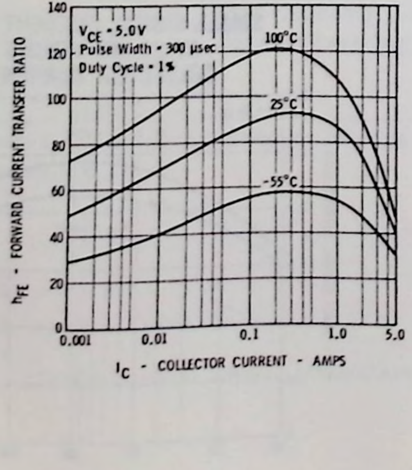




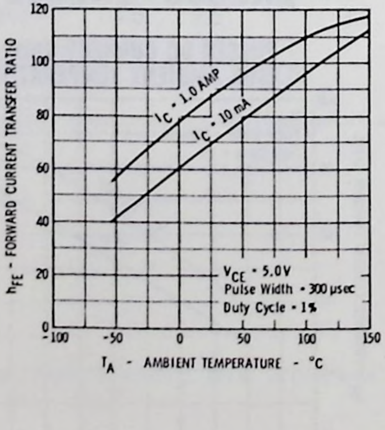
*** Single family characteristic on Transistor Curve Tracer.**

2N2891 • 2N2893

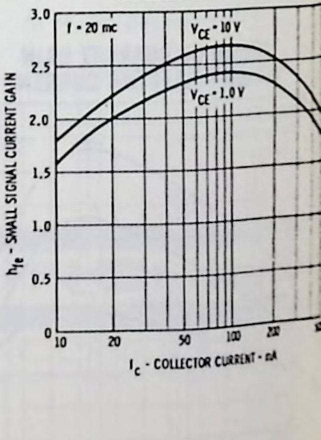
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



PULSED DC CURRENT GAIN VERSUS AMBIENT TEMPERATURE

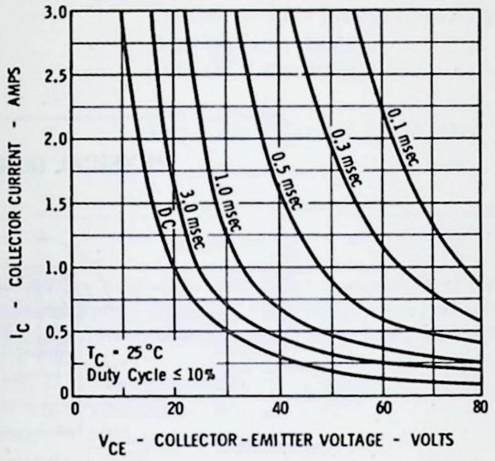


SMALL SIGNAL CURRENT GAIN AT 20 MC VERSUS COLLECTOR CURRENT

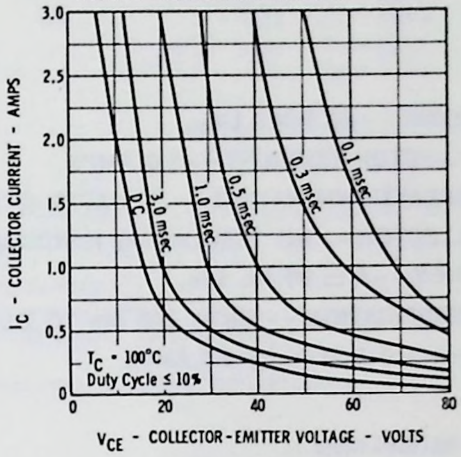


2N2892 • 2N2893

MAXIMUM ALLOWABLE PEAK CURRENT VERSUS COLLECTOR-EMITTER VOLTAGE

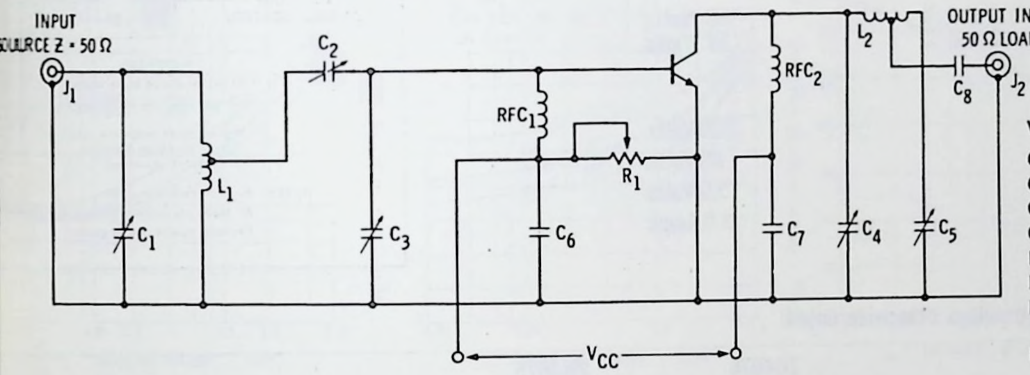


MAXIMUM ALLOWABLE PEAK CURRENT VERSUS COLLECTOR-EMITTER VOLTAGE



20 MC AMPLIFIER

RF Power Output = 12 watts Gain = 7.0 db
Efficiency = 55% V_{CC} = 33 Volts

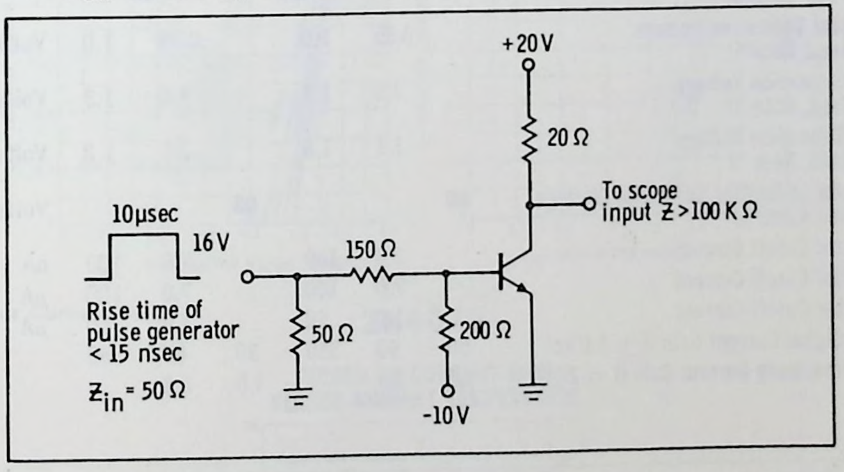

INPUT
SOURCE Z = 50 Ω
J_1
C_2
L_1
C_1
C_3
RFC_1
R_1
C_6
RFC_2
C_7
C_4
C_5
L_2
OUTPUT INTO
50 Ω LOAD
C_8
J_2
V_{CC}

Variable capacitors are Elmenco compression type

C_1, C_2	7 plates	360-1000 pf
C_3	5 plates	170-760 pf
C_4, C_5	4 plates	100-550 pf
C_6, C_7, C_8	.01μfd —50 V Sprague disc type	
R_1	50Ω potentiometer (set at 0.5Ω min.)	
RFC_1	Ohmite Plate Choke Z —28	
RFC_2	100 turns #20 Nyclad Magnet wound on 2KΩ —10W ceramic resistor	
L_1	4 turns 508 Air Dux tapped at 1⅞ turns from input	
L_2	7 turns 508 Air Dux tapped at 2¼ turns from output	
J_1, J_2	BNC connectors	

This circuit constructed on 1⁄16" x 3⅞" x 5⅞" copper clad printed circuit board.
Transistor must be used with adequate heat sink.

T_{ON} and T_{OFF} TEST CIRCUIT (For All Transistors)


+20V
20 Ω
To scope
input Z > 100 K Ω
10μsec
16 V
150 Ω
50 Ω
200 Ω
-10V
Rise time of
pulse generator
< 15 nsec
Z_{in} = 50 Ω

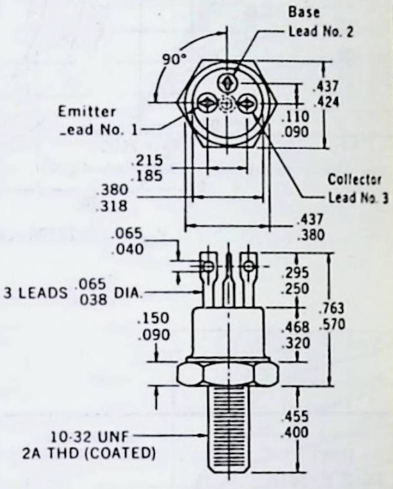
2N4075 • 2N4076

NPN HIGH-POWER, HIGH-VOLTAGE TYPE

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

- **HIGH BREAKDOWN -- 80 VOLT LV_{CEO}**
- **MAXIMUM COLLECTOR CURRENT -- 3.0 AMPS.**
- **SECONDARY BREAKDOWN RATING -- 17 WATTS @ $T_C = 100°C$**
- **ISOLATED COLLECTOR -- NO INSULATING HARDWARE REQUIRED**
- **HIGH FREQUENCY -- $f_T = 30$ Mc Min.**
- **WIDE BETA SPECIFICATION -- FROM 100 mA TO 2.0 AMPS.**
- **LOW V_{CE} (sat) -- 1.0 V Max. @ 2.0 AMPS.**

PHYSICAL DIMENSIONS



HARDWARE

Flat nickel-plated brass washer

$\frac{.205}{.230}$ ID $\frac{.475}{.505}$ OD $\frac{.040}{.070}$ THICK

Nickel-plated brass hex nut
10-32 American Standard
double chamfered

NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 sec time limit)	+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	30 Watts
at 100°C Case Temperature [Notes 2 and 3]	**17 Watts**

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	100 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	80 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	3.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N4076			2N4075					
SYMBOL	CHARACTERISTIC	Min.	Typ.	Max.	Min.	Typ.	Max.	Units	TEST CONDITIONS	
$^{*}h_{FE}$	DC Pulse Current Gain [Note 5]	50	80	150	30	55	90		$I_C = 1.0$ A	$V_{CE} = 2.0$ V
h_{FE}	**DC Pulse Current Gain** [Note 5]	**40**	75		**25**	50			**$I_C = 2.0$ A**	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** [Note 5]	**35**	80		**20**	55			**$I_C = 100$ mA**	$V_{CE} = 2.0$ V
V_{CE} (sat)	Collector Saturation Voltage [pulsed, Note 5]		0.2	0.5		0.2	0.5	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$^{*}V_{CE}$ (sat)	**Collector Saturation Voltage** [pulsed, Note 5]		0.35	**1.0**		0.35	**1.0**	Volts	**$I_C = 2.0$ A**	$I_B = 0.2$ A
V_{BE} (sat)	Base Saturation Voltage [pulsed, Note 5]		1.0	1.3		1.0	1.3	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$^{*}V_{BE}$ (sat)	Base Saturation Voltage [pulsed, Note 5]		1.1	1.8		1.1	1.8	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	**80**			**80**			Volts	$I_C = 100$ mA	$I_B = 0$ (pulsed)
$^{*}I_{CEX}$	Collector Cutoff Current		2.0	100		2.0	100	nA	$V_{CE} = 60$ V	$V_{BE} = -2.0$ V
I_{CEX} (150°C)	Collector Cutoff Current		7.0	100		7.0	100	μA	$V_{CE} = 60$ V	$V_{BE} = -2.0$ V
I_{CEO}	Collector Cutoff Current		1.0	50		1.0	50	μA	$V_{CE} = 60$ V	$I_B = 0$
h_{fe}	Small Signal Current Gain (f = 1.0 kc)	50	90	350	30	65	250		$V_{CE} = 10$ V	$I_C = 50$ mA
h_{fe}	**High Frequency Current Gain (f = 20 Mc)**	**1.5**	2.5		**1.5**	2.3			$V_{CE} = 10$ V	$I_C = 200$ mA

Additional Electrical Characteristics on page 2
Notes on page 2

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS 2N4075 • 2N4076

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4076 Min.	2N4076 Typ.	2N4076 Max.	2N4075 Min.	2N4075 Typ.	2N4075 Max.	Units	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	100			100			Volts	$I_C = 100\ \mu A$ $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			Volts	$I_E = 10\ \mu A$ $I_C = 0$
t_{on}	Turn On Time [Note 6]			0.3			0.3	μsec	$I_C = 1.0$ A $I_{B1} \approx 50$ mA
t_{off}	Turn Off Time [Note 6]			1.5			1.5	μsec	$I_C = 1.0$ A $I_{B1} \approx 50$ mA $I_{B2} \approx -50$ mA
C_{obo}	Open Circuit Output Capacitance			70			70	pf	$I_E = 0$ $V_{CB} = 10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 5.83°C/Watt. See power curves for derating characteristics.

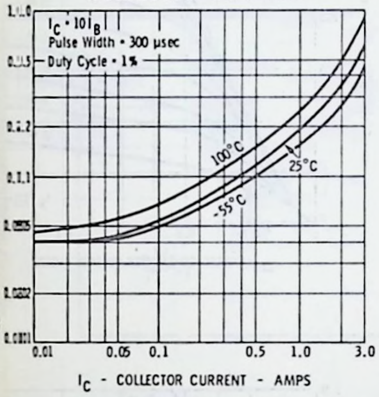
(4) These ratings refer to a high-current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

(5) Pulse conditions: length = 300 μsec; duty cycle = 1%.

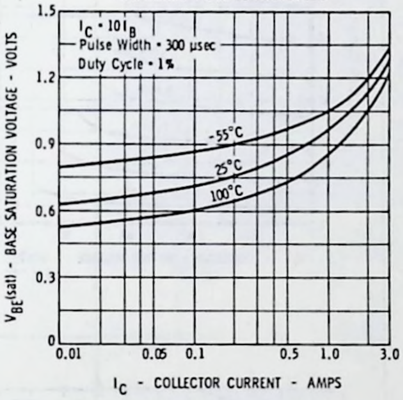
(6) See switching circuit for exact I_{B1} and I_{B2} values.

TYPICAL ELECTRICAL CHARACTERISTICS FOR 2N4075 AND 2N4076

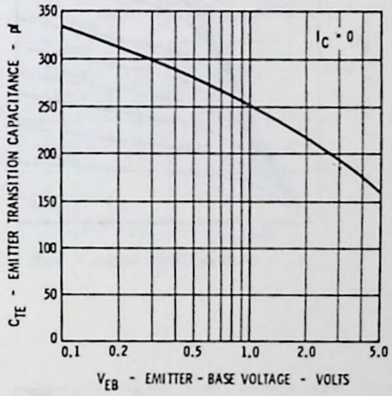
COLLECTOR SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



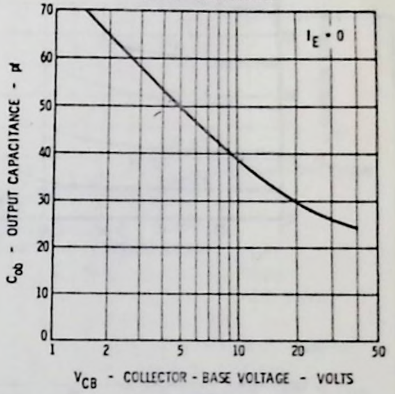
BASE SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



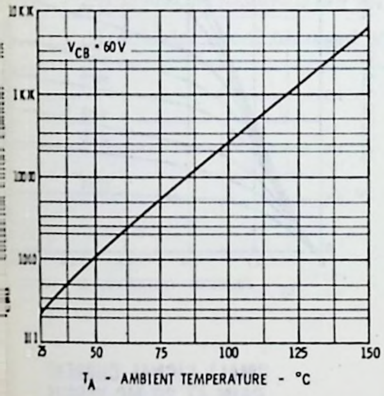
EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



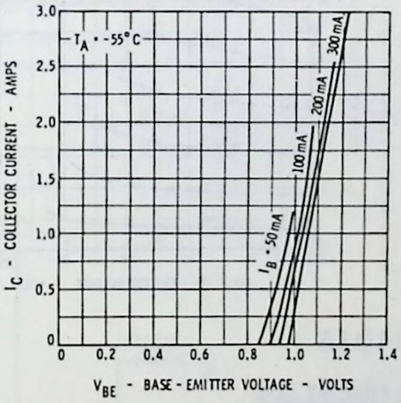
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



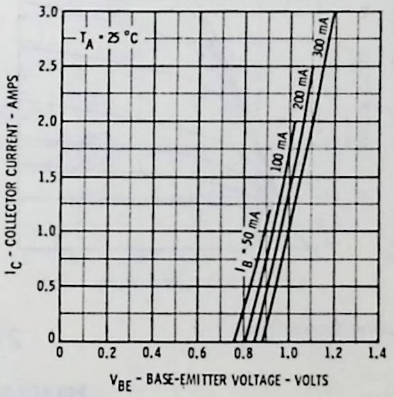
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



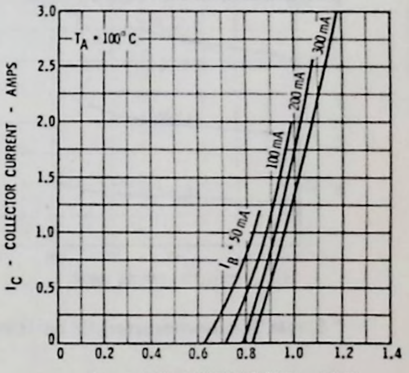
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



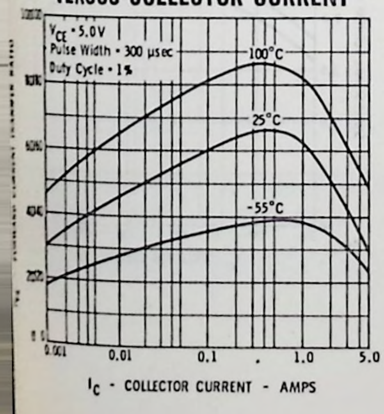
BASE CHARACTERISTICS*



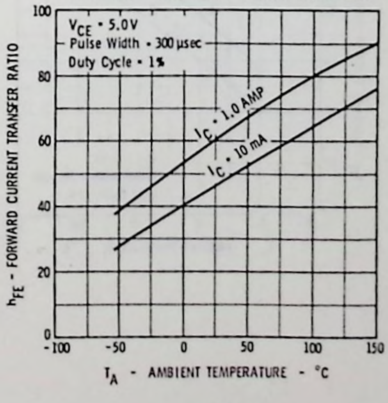
*Single family characteristic on Transistor Curve Tracer.

2N4075

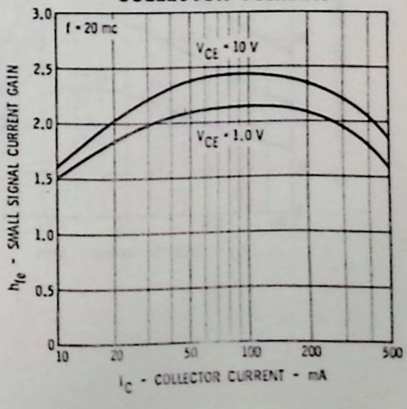
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



PULSED DC CURRENT GAIN VERSUS AMBIENT TEMPERATURE



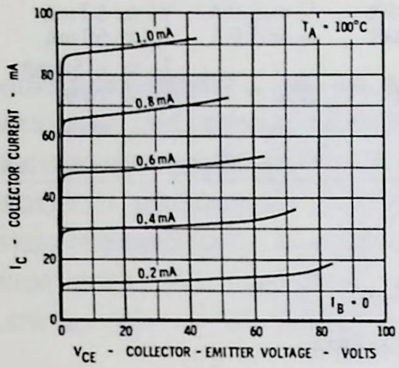
SMALL SIGNAL CURRENT GAIN AT 20 MC VERSUS COLLECTOR CURRENT

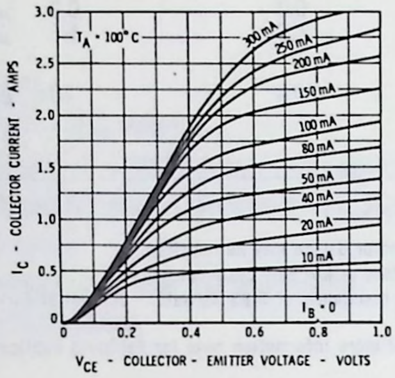


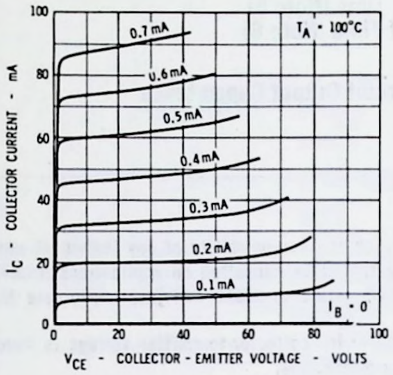
TYPICAL COLLECTOR CHARACTERISTICS*

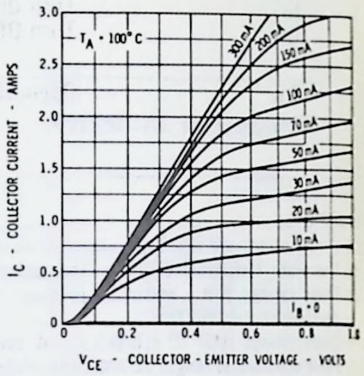
2N4075

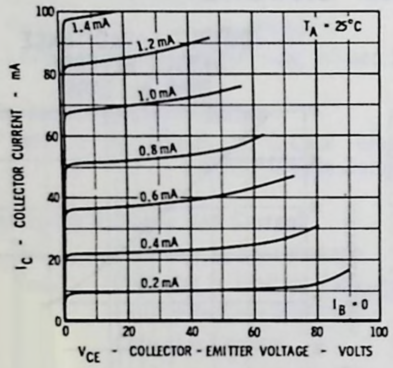
2N4076

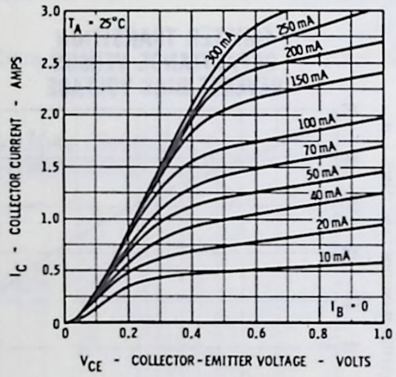


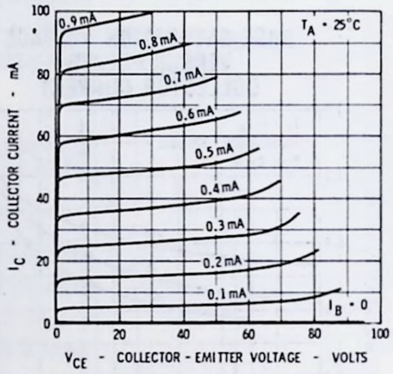


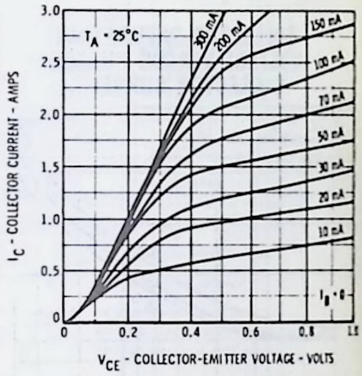


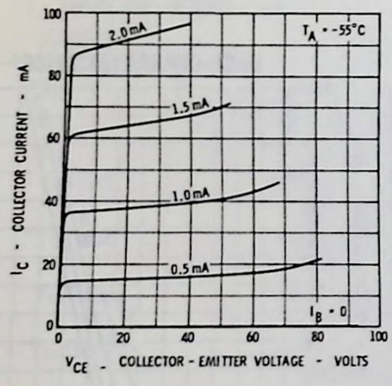


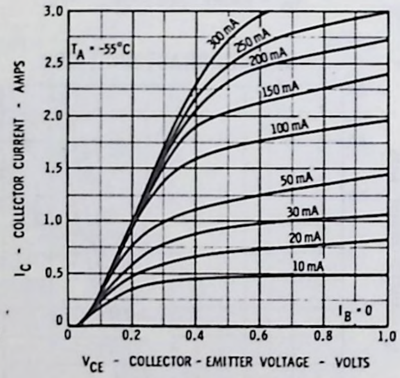


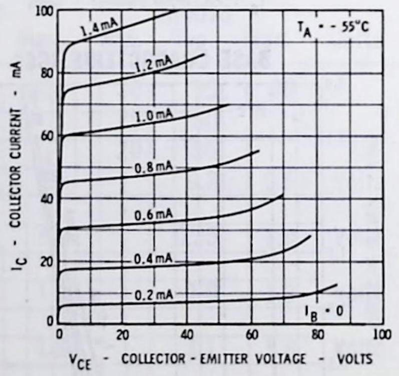


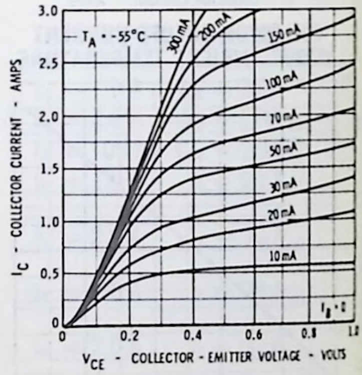








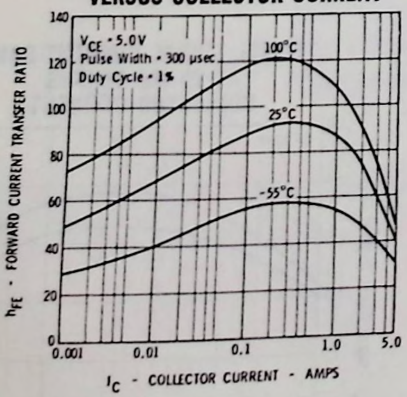




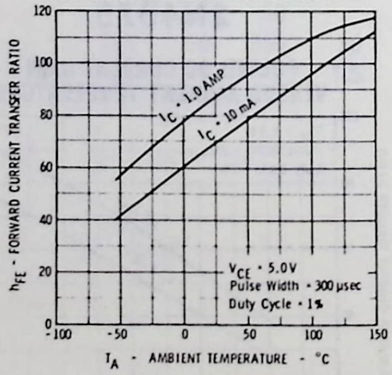
* **Single family characteristic on Transistor Curve Tracer.**

2N4076

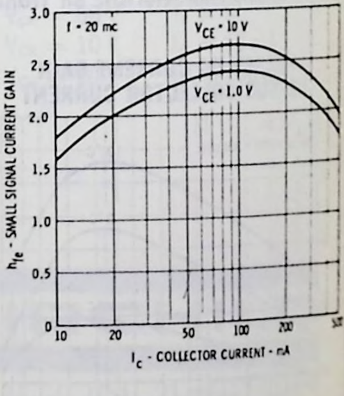
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT

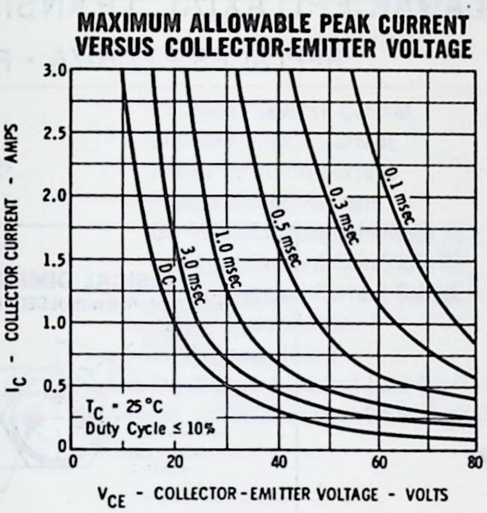


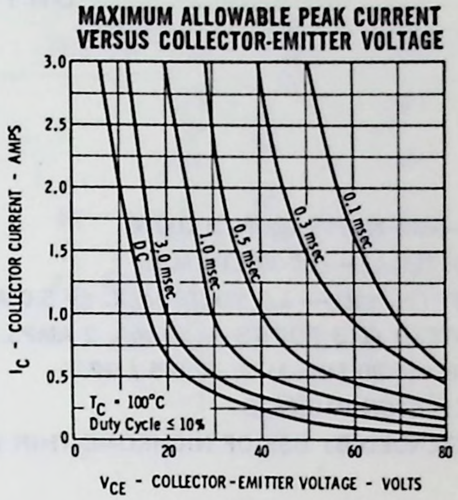
PULSED DC CURRENT GAIN VERSUS AMBIENT TEMPERATURE



SMALL SIGNAL CURRENT GAIN AT 20 MC VERSUS COLLECTOR CURRENT



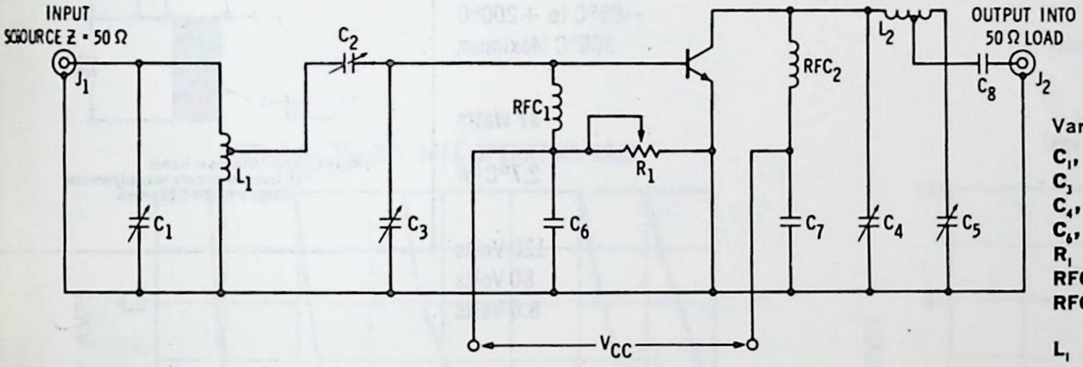




20 MC AMPLIFIER

RF Power Output = 12 watts
Efficiency = 55%

Gain = 7.0 db
V_{cc} = 33 Volts


INPUT
SOURCE Z = 50 Ω
J_1
C_2
L_1
C_1
C_3
RFC_1
R_1
C_6
RFC_2
C_7
C_4
L_2
C_5
C_8
OUTPUT INTO
50 Ω LOAD
J_2
V_{CC}

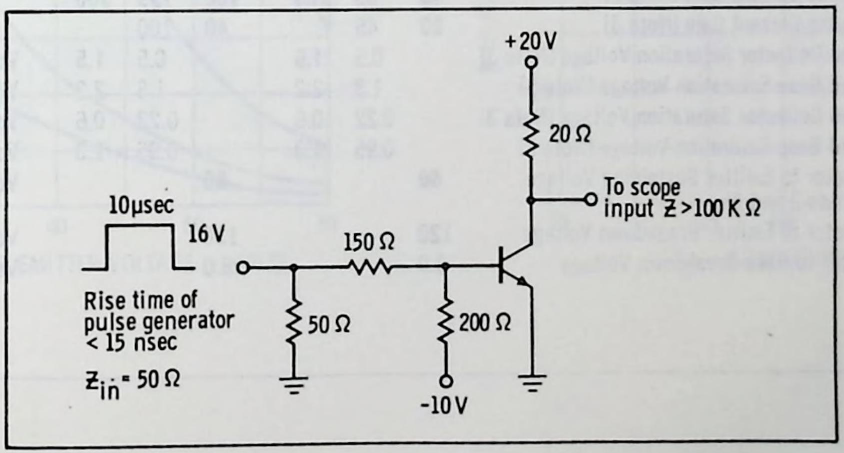
Variable capacitors are Elmenco compression type

C_1, C_2	7 plates 360-1000 pf
C_3	5 plates 170-760 pf
C_4, C_5	4 plates 100-550 pf
C_6, C_7, C_8	.01μfd —50 V Sprague disc type
R_1	50Ω potentiometer (set at 0.5Ω min.)
RFC_1	Ohmite Plate Choke Z —28
RFC_2	100 turns #20 Nyclad Magnet wound on 2KΩ —10W ceramic resistor
L_1	4 turns 508 Air Dux tapped at 1⅞ turns from input
L_2	7 turns 508 Air Dux tapped at 2¼ turns from output
J_1, J_2	BNC connectors

This circuit constructed on 1/16" x 3⅞" x 5⅞" copper clad printed circuit board.

Transistor must be used with adequate heat sink.

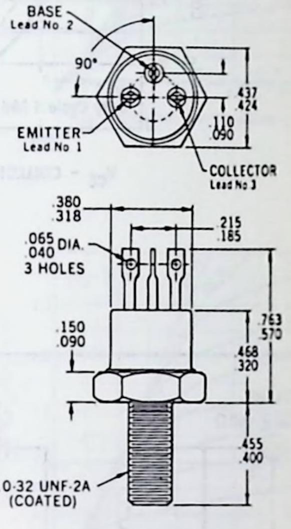
T_{ON} and T_{OFF} TEST CIRCUIT


+20V
20 Ω
To scope
input Z > 100 K Ω
10μsec
16 V
150 Ω
Rise time of
pulse generator
< 15 nsec
Z_{in} = 50 Ω
50 Ω
200 Ω
-10V

2N4115 • 2N4116
NPN POWER TRANSISTORS
DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS
REPLACES FT7207A • FT7207B

- **HIGH POWER — 37 WATTS @ $T_C = 100°C$**
- **HIGH VOLTAGE (LV_{CEO}) — 80 VOLTS MIN.**
- **HIGH CURRENT (V_{CE} sat) — 1.5 VOLTS MAX. @ 5.0 AMPS.**
- **BETA GUARANTEED @ 3 POINTS — 50 mA, 2 AMPS. and 5 AMPS.**
- **HIGH (f_T) — 70 and 80 MHz MIN. @ 0.5 AMP.**
- **ISOLATED COLLECTOR PACKAGE**
- **SAFE AREA EXTENDED BY USE OF NICHROME THIN FILM EMITTER RESISTOR**

PHYSICAL DIMENSIONS
(in accordance with JEDEC TO-59 outline)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 5.65 grams

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum

Maximum Power Dissipation

Total Dissipation at 100°C Case Temperature (See safe operating area and derating curves)	**37 Watts**
Thermal Resistance	2.7°C/W

Maximum Voltages

V_{CBO}	Collector to Base Voltage	120 Volts
V_{CEO}	Collector to Emitter Voltage [Note 2]	80 Volts
V_{EBO}	Emitter to Base Voltage	**8.0 Volts**

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4115 MIN.	2N4115 TYP.	2N4115 MAX.	2N4116 MIN.	2N4116 TYP.	2N4116 MAX.	UNITS	TEST CONDITIONS
*h_{FE}	DC Pulse Current Gain [Note 3]	**40**	63	**120**	**100**	139	**300**		I_C = **2.0 A** V_{CE} = 5.0 V
h_{FE}	DC Pulse Current Gain [Note 3]	**20**	45		**40**	100			I_C = **5.0 A** V_{CE} = 5.0 V
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 3]		0.5	**1.5**		0.5	**1.5**	Volts	I_C = **5.0 A** I_B = 0.5 A
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 3]		1.3	2.2		1.3	2.2	Volts	I_C = 5.0 A I_B = 0.5 A
*V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 3]		0.22	0.6		0.22	0.6	Volts	I_C = 2.0 A I_B = 0.2 A
*V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 3]		0.95	1.3		0.95	1.3	Volts	I_C = 2.0 A I_B = 0.2 A
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 2 and 3]	**80**			**80**			Volts	I_C = 50 mA I_B = 0 (pulsed)
BV_{CES}	Collector to Emitter Breakdown Voltage	120			120			Volts	I_C = 2.0 mA V_{BE} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	8.0			8.0			Volts	I_C = 0 I_E = 1.0 mA

Notes on page 2

Additional Electrical Characteristics on page 2

FAIRCHILD
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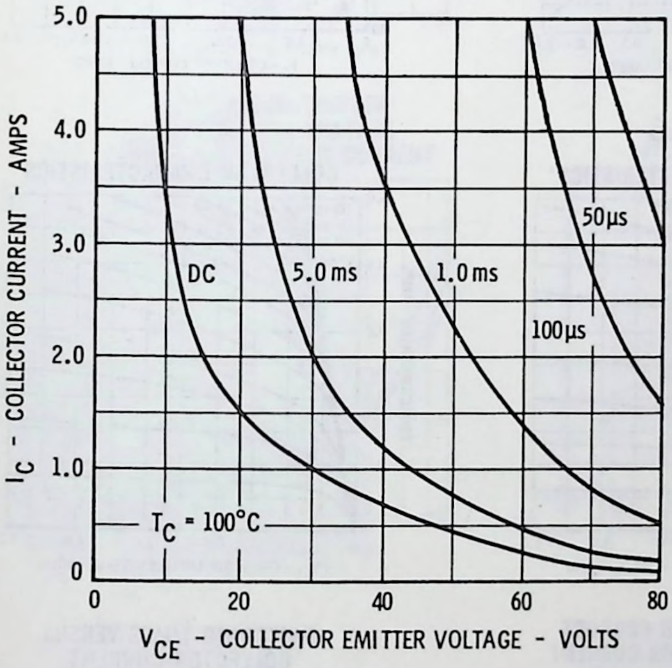
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

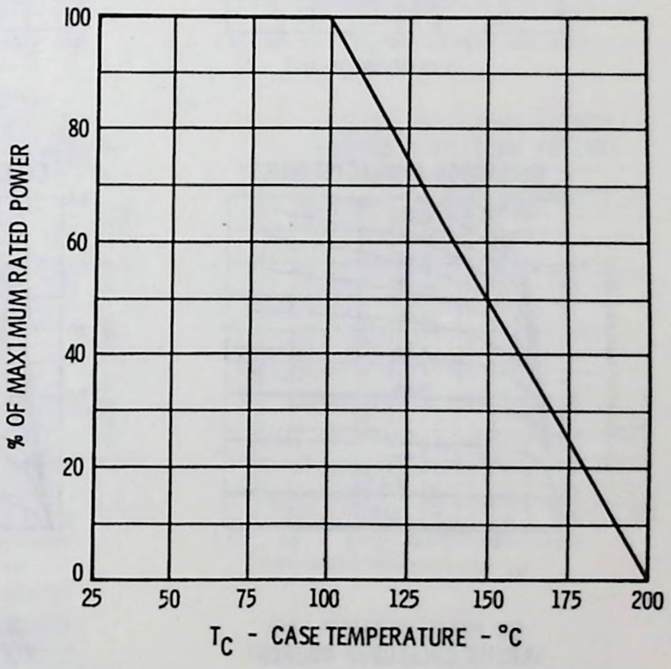
ELLECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4115			2N4116			UNITS	TEST CONDITIONS	
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
*I_{CES}	Collector Reverse Current			10			10	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{CEO}	Collector Cutoff Current			50			50	μA	$I_B = 0$	$V_{CE} = 40$ V
I_{CEX} (150°C)	Collector Cutoff Current			100			100	μA	$V_{CE} = 60$ V	$V_{EB} = 2.0$ V
I_{EBO}	Emitter Cutoff Current			25			25	μA	$I_C = 0$	$V_{EB} = 6.0$ V
h_{FE}	DC Pulse Current Gain [Note 3]	**20**	40		**40**	72			$I_C =$ **50 mA**	$V_{CE} = 5.0$ V
h_{FE} (−55°C)	DC Pulse Current Gain [Note 3]	15	34		35	82			$I_C = 2.0$ A	$V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	**3.5**	6.75		**4.0**	9.75			$I_C = 0.5$ A	$V_{CE} = 5.0$ V
C_{obo}	Output Capacitance		80	120		80	120	pF	$I_E = 0$	$V_{CE} = 10$ V
C_{ibo}	Input Capacitance		450	700		450	700	pF	$I_C = 0$	$V_{EB} = 2.0$ V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	20			40				$I_C = 50$ mA	$V_{CE} = 5.0$ V
V_{BE} (ON)	Pulsed Base Emitter ON Voltage [Note 3]			1.3			1.3	Volts	$I_C = 2.0$ A	$V_{CE} = 5.0$ V

FORWARD BIASED SAFE OPERATING AREA



DERATING CURVE



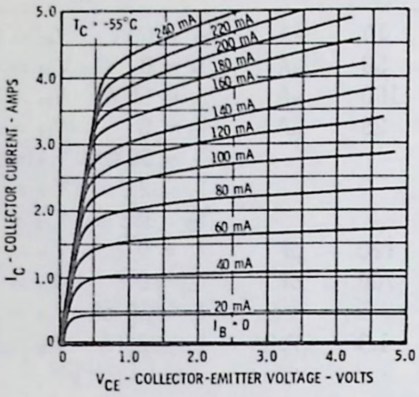
NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
(2) This rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse conditions: length = 300 μs; duty cycle = 1%.

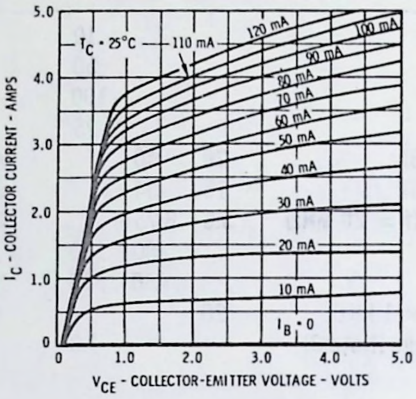
TYPICAL ELECTRICAL CHARACTERISTICS

2N4115

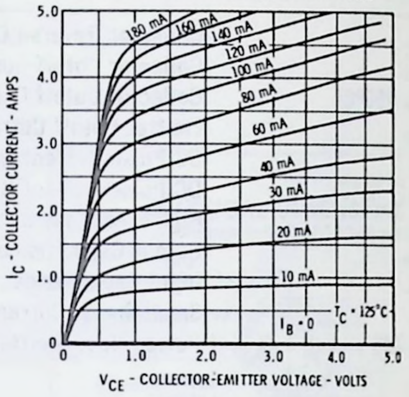
COLLECTOR CHARACTERISTICS*



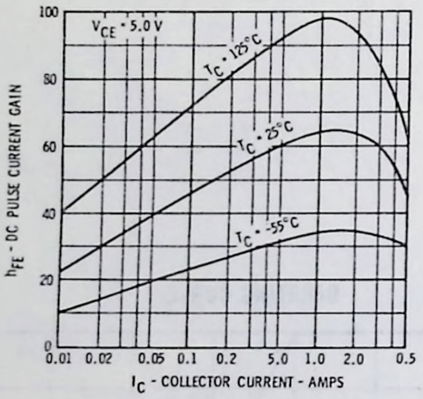
COLLECTOR CHARACTERISTICS*



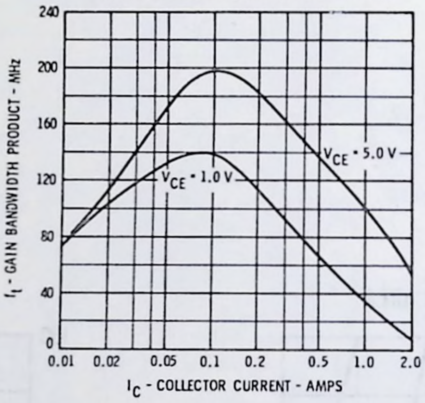
COLLECTOR CHARACTERISTICS*



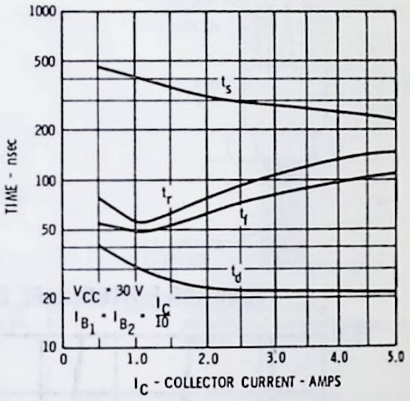
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

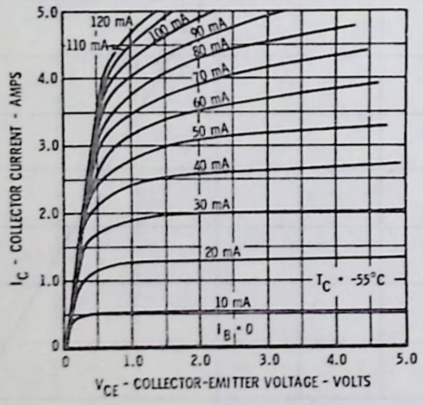


SWITCHING TIMES VERSUS COLLECTOR CURRENT

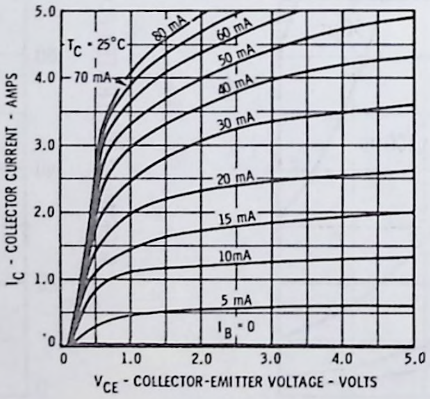


2N4116

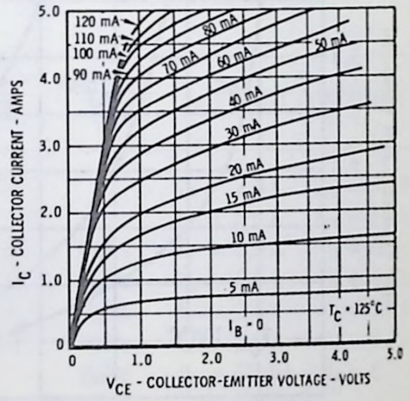
COLLECTOR CHARACTERISTICS*



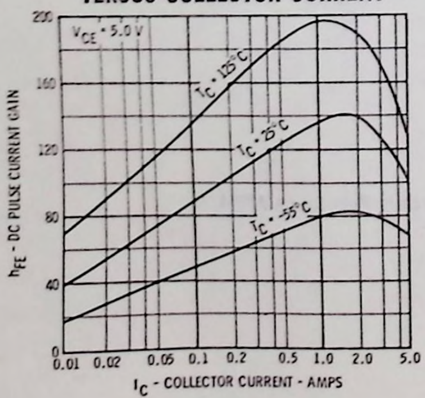
COLLECTOR CHARACTERISTICS*



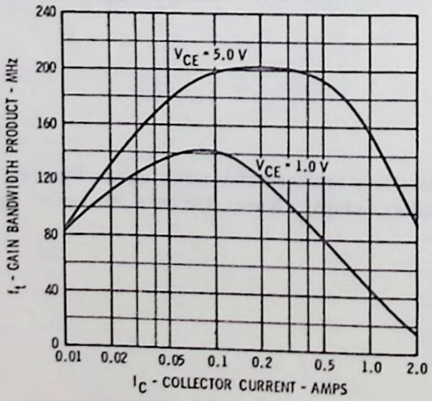
COLLECTOR CHARACTERISTICS*



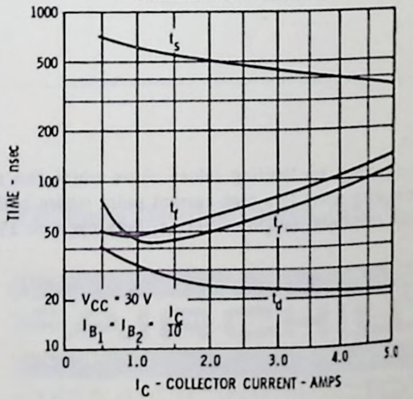
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT

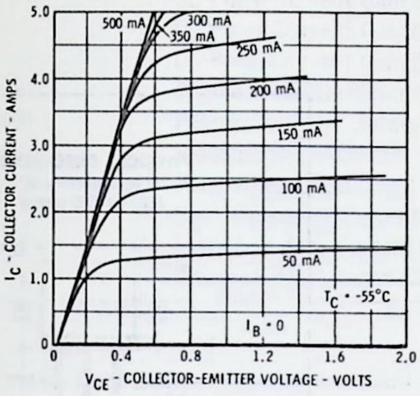


* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

2N4115•2N4116

COLLECTOR CHARACTERISTICS*



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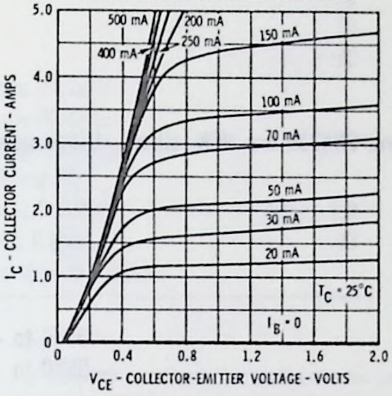

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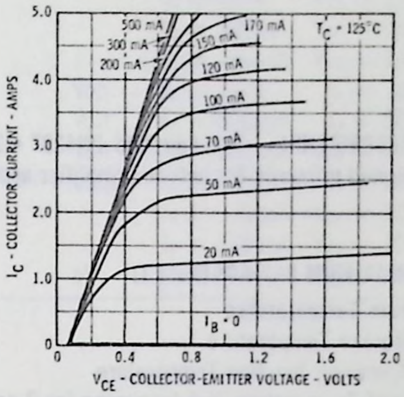
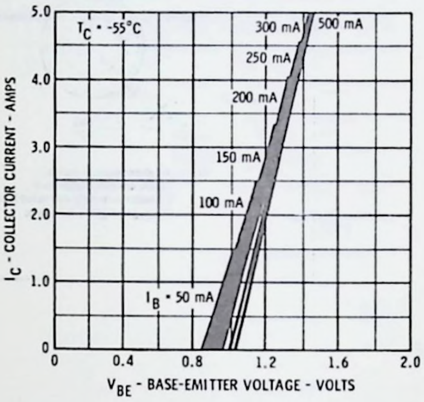
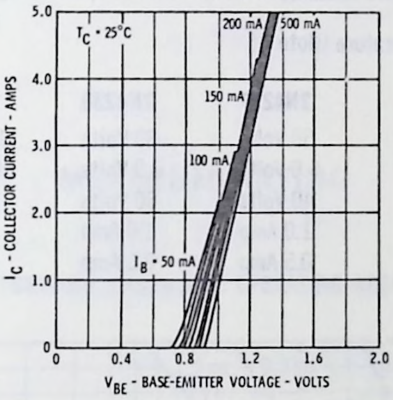


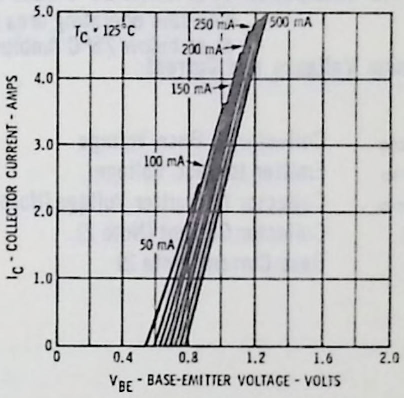
BASE CHARACTERISTICS*



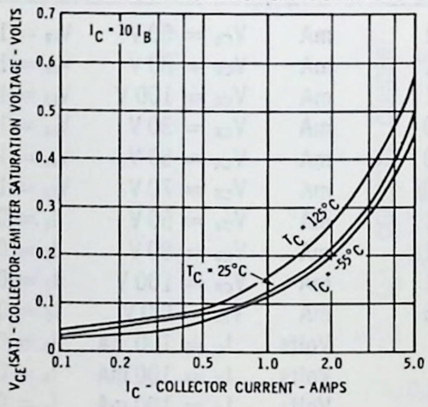
BASE CHARACTERISTICS*



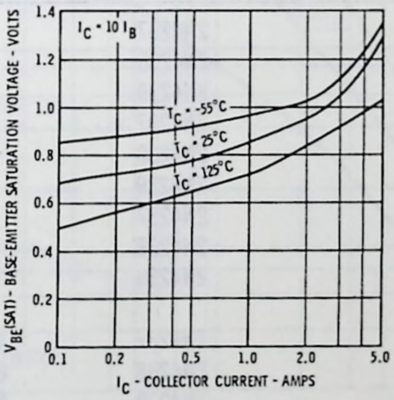
BASE CHARACTERISTICS*



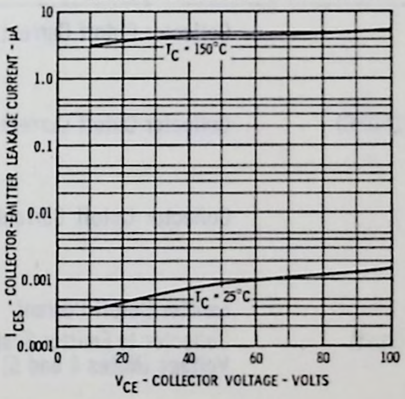
COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



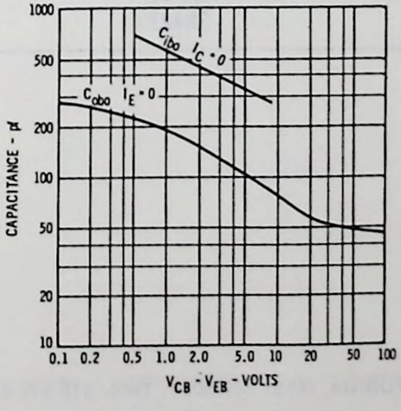
BASE EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR LEAKAGE CURRENT VERSUS COLLECTOR VOLTAGE



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



* : Single family characteristic on Transistor Curve Tracer.

2N4237 · 2N4238 · 2N4239

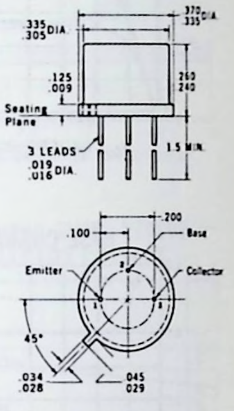
NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

FOR IMPROVED PERFORMANCE SEE FAIRCHILD 2N4895 • 2N4896 • 2N4897

GENERAL DESCRIPTION — The Fairchild 2N4237 • 2N4238 and 2N4239 are NPN, silicon, triode power transistors designed primarily for untuned amplifier applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 1.1 grams

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +200°C
Operating Junction Temperature	−55°C to +200°C
Lead Temperature ¼″ from case for 2 seconds	+230°C

Maximum Power Dissipation

Total Dissipation at or below 25°C Case Temperature [Note 3]	5.0 Watts
(See safe operating area curve) at or below 25°C Ambient Temperature [Note 3]	0.8 Watt

Maximum Voltages and Current

		2N4237	2N4238	2N4239
V_{CBO}	Collector to Base Voltage	50 Volts	80 Volts	100 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts	6.0 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	40 Volts	60 Volts	80 Volts
I_C	Collector Current [Note 2]	1.0 Amp	1.0 Amp	1.0 Amp
I_B	Base Current [Note 2]	0.5 Amp	0.5 Amp	0.5 Amp

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN	MAX.	UNITS	TEST CONDITIONS	
I_{CEX}	Collector Cutoff Current	2N4237		0.1	mA	V_{CE} = 50 V	V_{EB} = 1.5 V
		2N4238		0.1	mA	V_{CE} = 80 V	V_{EB} = 1.5 V
		2N4239		0.1	mA	V_{CE} = 100 V	V_{EB} = 1.5 V
I_{CEX} (150°C)	Collector Cutoff Current	2N4237		1.0	mA	V_{CE} = 30 V	V_{EB} = 1.5 V
		2N4238		1.0	mA	V_{CE} = 50 V	V_{EB} = 1.5 V
		2N4239		1.0	mA	V_{CE} = 70 V	V_{EB} = 1.5 V
I_{CBO}	Collector Cutoff Current	2N4237		0.1	mA	V_{CB} = 50 V	$I_E = 0$
		2N4238		0.1	mA	V_{CB} = 80 V	$I_E = 0$
		2N4239		0.1	mA	V_{CB} = 100 V	$I_E = 0$
I_{EBO}	Emitter Cutoff Current			0.5	mA	V_{EB} = 6.0 V	$I_C = 0$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	2N4237	40		Volts	I_C = 100 mA	$I_B = 0$
		2N4238	60		Volts	I_C = 100 mA	$I_B = 0$
		2N4239	80		Volts	I_C = 100 mA	$I_B = 0$
I_{CEO}	Collector Cutoff Current	2N4237		1.0	mA	V_{CE} = 30 V	$I_B = 0$
		2N4238		1.0	mA	V_{CE} = 40 V	$I_B = 0$
		2N4239		1.0	mA	V_{CE} = 60 V	$I_B = 0$

Additional Electrical Characteristics on page 2. Notes on page 2.

*Planar is a patented Fairchild

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD TRANSISTORS 2N4237 • 2N4238 • 2N4239

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	15			$I_C = 1.0$ A	$V_{CE} = 1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30			$I_C = 500$ mA	$V_{CE} = 4.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	30	150		$I_C = 250$ mA	$V_{CE} = 1.0$ V
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.6	Volt	$I_C = 1.0$ A	$I_B = 100$ mA
V_{CE} (sat)	Pulsed Collector Saturation Voltage [Note 5]		0.3	Volt	$I_C = 500$ mA	$I_B = 50$ mA
V_{BE} (on)	Pulsed Base to Emitter "ON" Voltage [Note 5]		1.0	Volt	$I_C = 250$ mA	$V_{CE} = 1.0$ V
V_{BE} (sat)	Pulsed Base Saturation Voltage [Note 5]		1.5	Volts	$I_C = 1.0$ A	$I_B = 100$ mA
h_{fe}	High Frequency Current Gain (f = 1.0 MHz)	1.0			$I_C = 100$ mA	$V_{CE} = 10$ V
h_{fe}	Low Frequency Current Gain (f = 1.0 kHz)	30			$I_C = 100$ mA	$V_{CE} = 10$ V
C_{ob}	Common Base Output Capacitance (f = 0.1 MHz)		100	pF	$I_E = 0$	$V_{CB} = 10$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

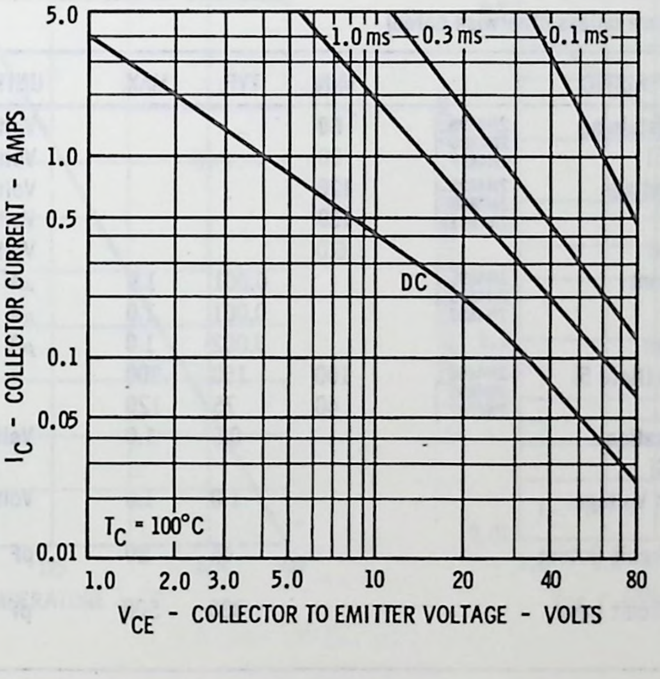
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/Watt (derating factor of 28.5 mW/°C); junction to ambient thermal resistance of 218.8°C/Watt (derating factor of 4.5 mW/°C).

(4) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

(5) Pulse Conditions: length = 300 μs; duty cycle = 2%.

MAXIMUM RATING

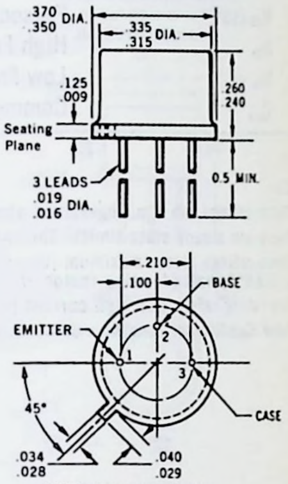
FORWARD BIASED SAFE OPERATING AREA



2N4895 • 2N4896 • 2N4897
NPN POWER TRANSISTORS
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE -- 150 AND 120 VOLT MIN. BV_{CES}, 80 AND 60 VOLT MIN LV_{CEO}**
- **LOW V_{CE} (sat) -- 1.0 VOLT MAX. @ $I_C = 5.0$ A, $I_B = 0.5$ A**
- **HIGH SPEED -- MAX. t_{on} OF 350 ns AND t_{off} OF 650 ns @ $I_C = 5.0$ A, $I_B = 0.5$ A**
- **HIGH FREQUENCY -- $f_T = 50$ AND 80 MHz MINIMUM**
- **LOW LEAKAGE -- MAX. I_{CES} OF 100 μA @ 150°C AS A RESULT OF PLANAR CONSTRUCTION**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES All dimensions in inches
Leads are gold plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature Range	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation [Notes 2 and 3]

Total Dissipation at 100°C Case Temperature (See Safe Operating Area and Derating Curves)	4.0 Watts
at 25°C Ambient Temperature	0.8 Watt

Maximum Voltages and Currents

		2N4895 2N4896	2N4897
V_{CBO}	Collector to Base Voltage	120 Volts	150 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	60 Volts	80 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	Collector Current	5.0 Amps	5.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{CEO} (sust)	**Collector to Emitter Sustaining Voltage** [Notes 4 and 5]	2N4895 2N4896	**60**			**Volts**	$I_C = 50$ mA	$I_B = 0$
		2N4897	**80**			**Volts**	$I_C = 50$ mA	$I_B = 0$
BV_{CES}	**Collector to Emitter Voltage**	2N4895 2N4896	**120**			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
		2N4897	**150**			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Voltage		6.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
I_{CES}	Collector Reverse Current	2N4895 2N4896		0.001	1.0	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
		2N4897		0.001	1.0	μA	$V_{CE} = 100$ V	$V_{BE} = 0$
I_{EBO}	Emitter Reverse Current			0.002	1.0	μA	$I_C = 0$	$V_{EB} = 4.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	2N4896	100	150	300		$I_C = 2.0$ A	$V_{CE} = 2.0$ V
		2N4895 2N4897	40	75	120		$I_C = 2.0$ A	$V_{CE} = 2.0$ V
V_{CE} (sat)	**Pulsed Collector Saturation Voltage** [Notes 5 and 6]			0.5	**1.0**	**Volts**	**$I_C = 5.0$ A**	**$I_B = 0.5$ A**
V_{BE} (sat)	Pulsed Base Saturation Voltage [Notes 5 and 6]			1.0	1.6	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
C_{obo}	Common-base, Open-circuit Output Capacitance			45	80	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{ibo}	Common-base, Open-circuit Input Capacitance			330	500	pF	$I_C = 0$	$V_{EB} = 0.5$ V

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* Planar is a patented Fairchild process

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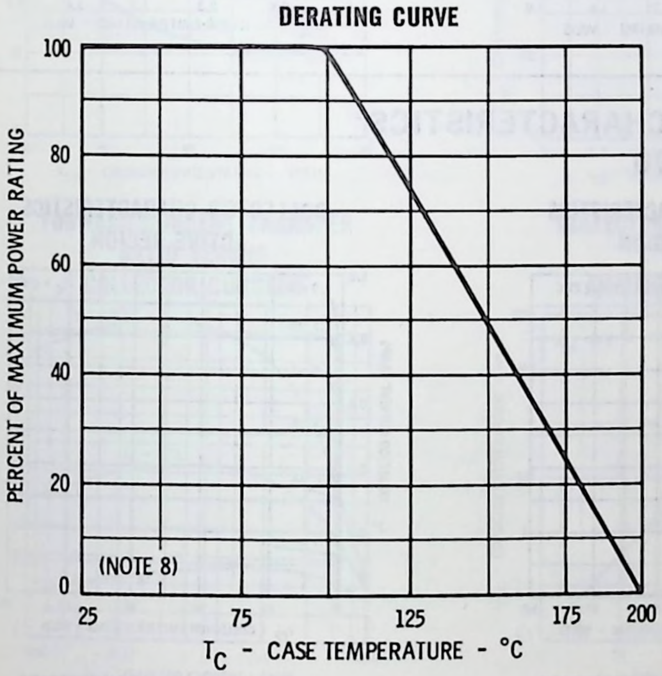
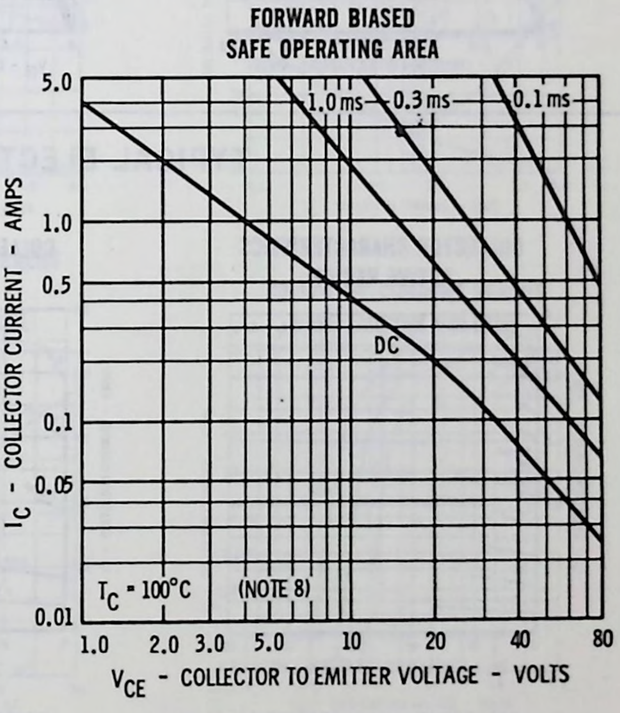
LECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
t_d	Delay Time [Note 7]			20	50	ns	$I_C = 5.0$ A	$I_{B1} = 0.5$ A
t_r	Rise Time [Note 7]			160	300	ns	$I_C = 5.0$ A	$I_{B1} = 0.5$ A
t_s	Storage Time [Note 7]			180	350	ns	$I_C = 5.0$ A	$I_{B1} = I_{B2} = 0.5$ A
t_f	Fall Time [Note 7]			120	300	ns	$I_C = 5.0$ A	$I_{B1} = I_{B2} = 0.5$ A
h_{fe}	High Frequency Current Gain	2N4896	4.0	6.0			$I_C = 500$ mA	$V_{CE} = 5.0$ V
	(f = 20 MHz)	2N4895 2N4897	2.5	6.0			$I_C = 500$ mA	$V_{CE} = 5.0$ V
h_{FE} (−55°C)	DC Pulse Current Gain	2N4896	35	75			$I_C = 2.0$ A	$V_{CE} = 2.0$ V
		2N4895 2N4897	15	40			$I_C = 2.0$ A	$V_{CE} = 2.0$ V
I_{CES} (150°C)	Collector Reverse Current	2N4895 2N4896		2.0	100	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
		2N4897		3.0	100	μA	$V_{CE} = 100$ V	$V_{BE} = 0$

MAXIMUM RATINGS


DERATING CURVE


FORWARD BIASED SAFE OPERATING AREA

OTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 25°C/Watt (derating factor of 40 mW/°C); junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C).

(4) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

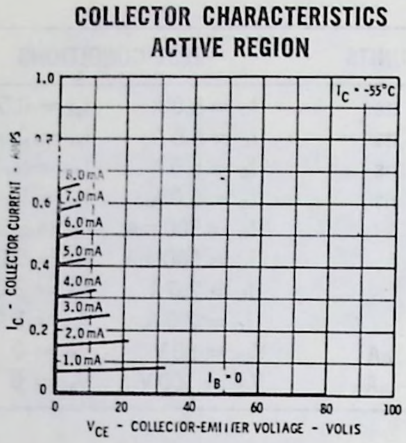
(6) Point of measurement: ¼″ from header.

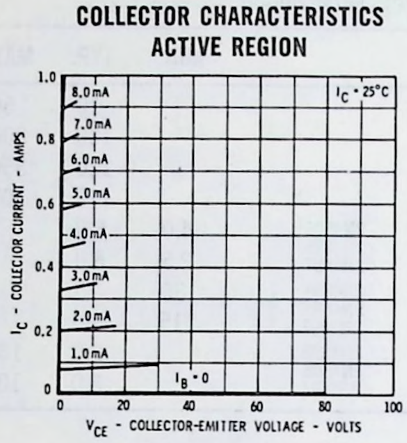
(7) Test conditions are given in the switching circuit.

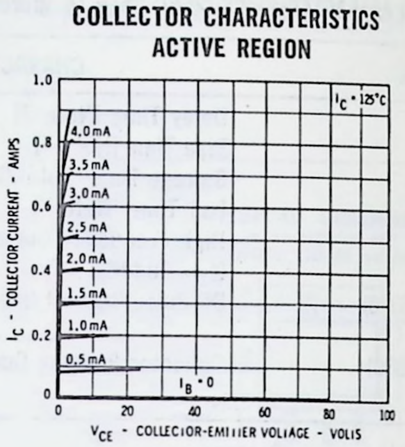
(8) The device is thermally limited under ambient conditions. Derate linearly at 4.56 mW/°C for ambient temperatures above 25°C.

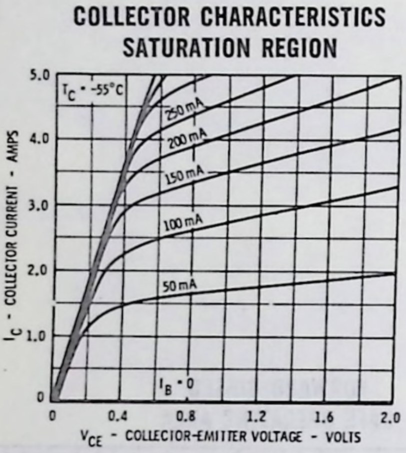
TYPICAL ELECTRICAL CHARACTERISTICS*

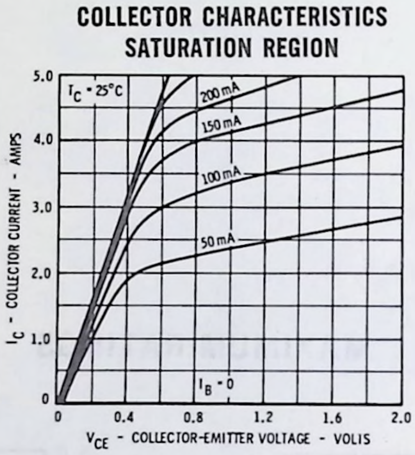
2N4895 • 2N4897

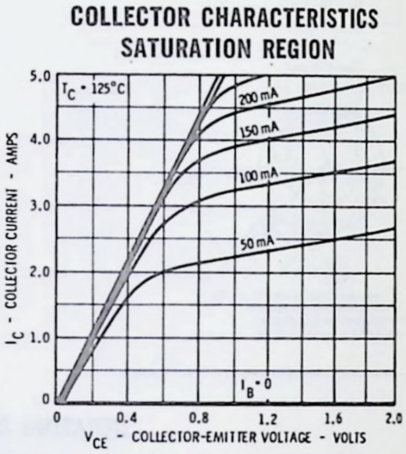

COLLECTOR CHARACTERISTICS ACTIVE REGION


COLLECTOR CHARACTERISTICS ACTIVE REGION


COLLECTOR CHARACTERISTICS ACTIVE REGION

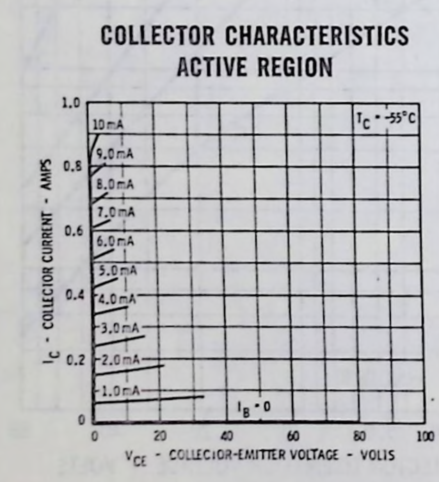

COLLECTOR CHARACTERISTICS SATURATION REGION

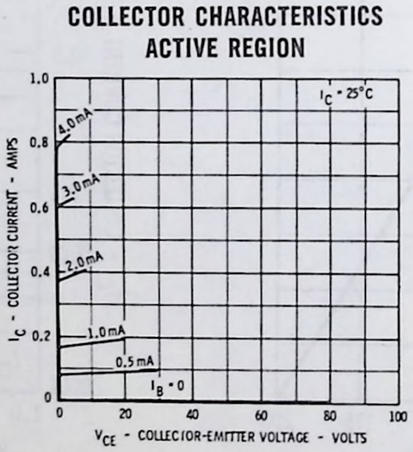

COLLECTOR CHARACTERISTICS SATURATION REGION

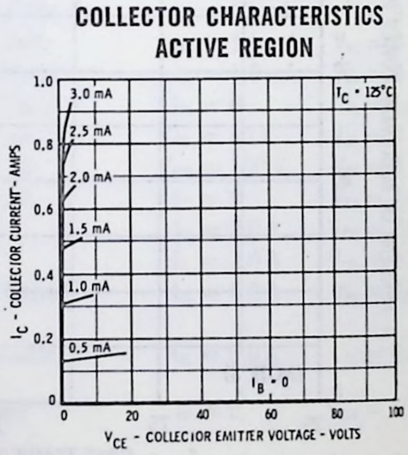

COLLECTOR CHARACTERISTICS SATURATION REGION

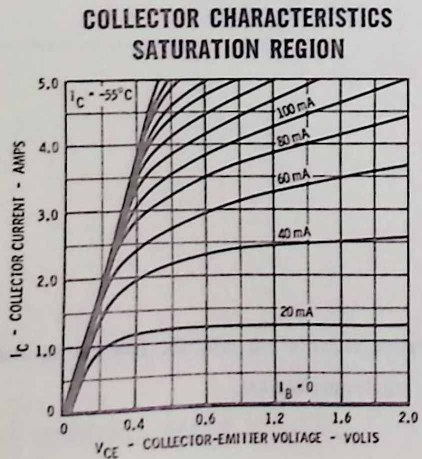
TYPICAL ELECTRICAL CHARACTERISTICS*

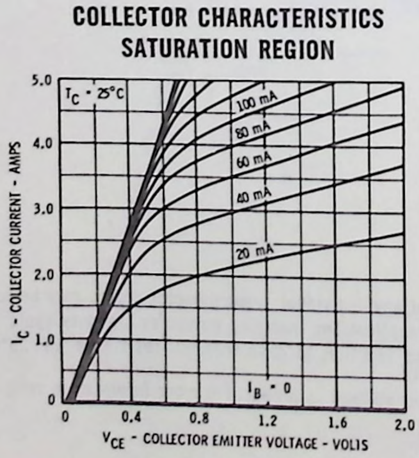
2N4896

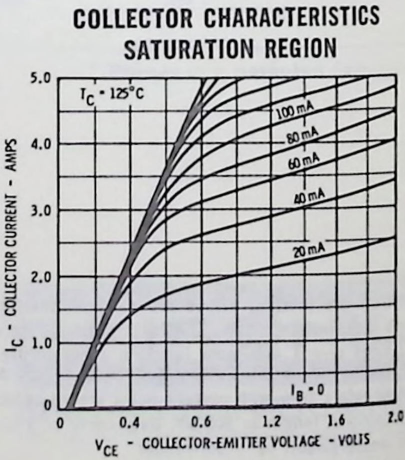

COLLECTOR CHARACTERISTICS ACTIVE REGION


COLLECTOR CHARACTERISTICS ACTIVE REGION


COLLECTOR CHARACTERISTICS ACTIVE REGION


COLLECTOR CHARACTERISTICS SATURATION REGION


COLLECTOR CHARACTERISTICS SATURATION REGION


COLLECTOR CHARACTERISTICS SATURATION REGION

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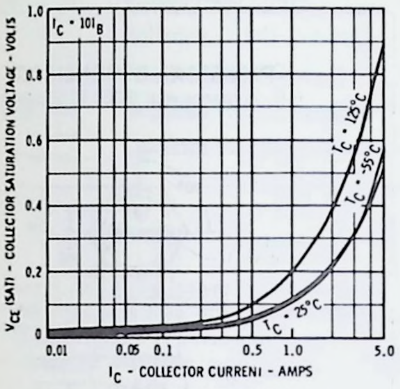
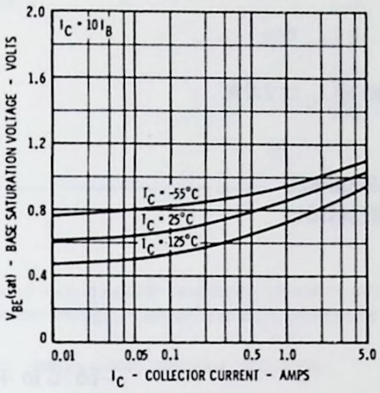
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

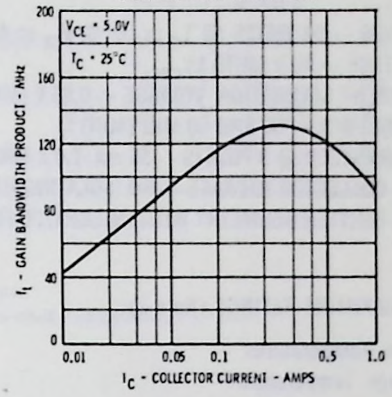
COLLECTOR SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



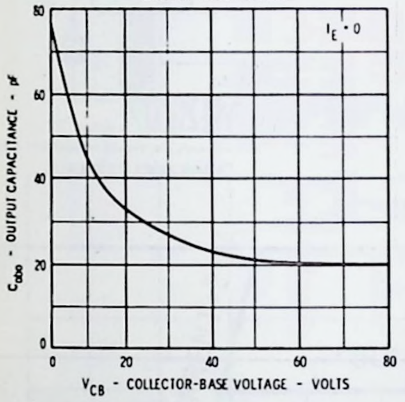
BASE SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



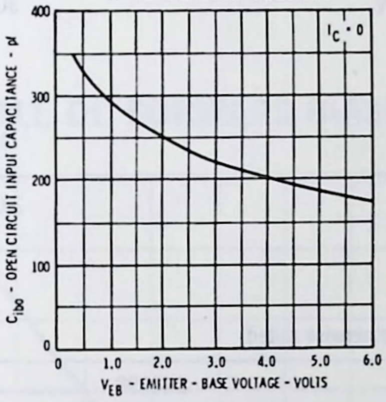
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



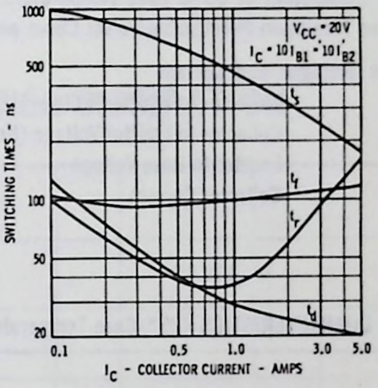
OPEN CIRCUIT OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



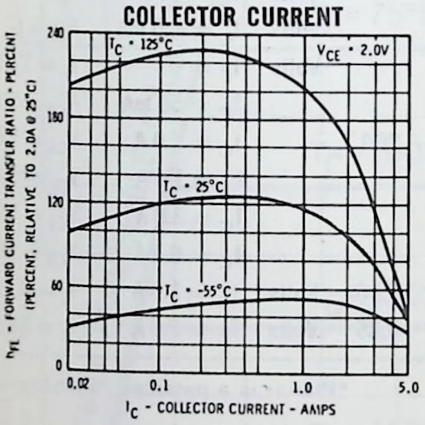
OPEN CIRCUIT INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



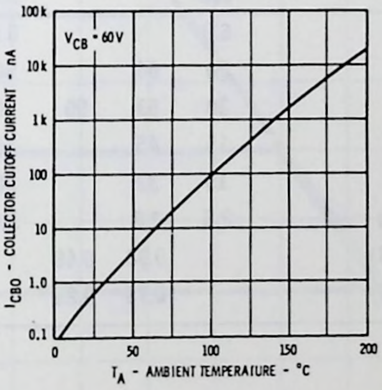
SWITCHING TIMES VERSUS COLLECTOR CURRENT



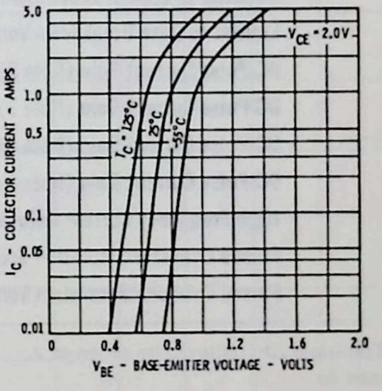
FORWARD CURRENT TRANSFER RATIO VERSUS COLLECTOR CURRENT



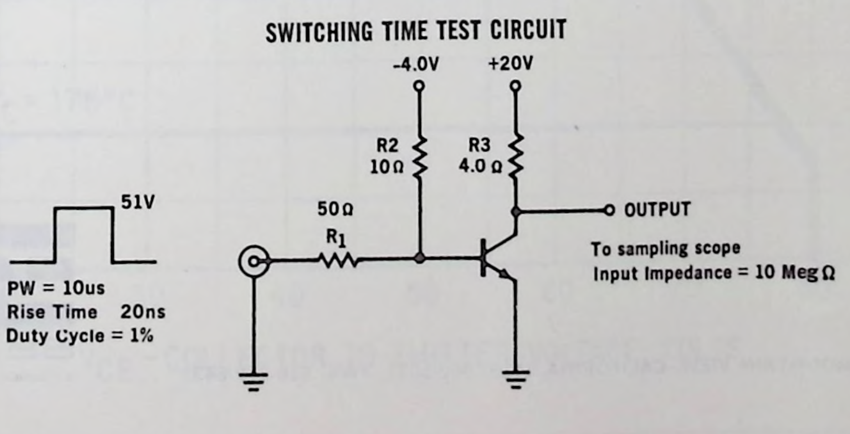
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



COLLECTOR CURRENT VERSUS BASE EMITTER VOLTAGE



SWITCHING TIME TEST CIRCUIT


-4.0V
+20V
R2
10 Ω
R3
4.0 Ω
51V
50 Ω
R_1
OUTPUT
To sampling scope
Input Impedance = 10 Meg Ω
PW = 10us
Rise Time 20ns
Duty Cycle = 1%

2N4998 • 2N5000

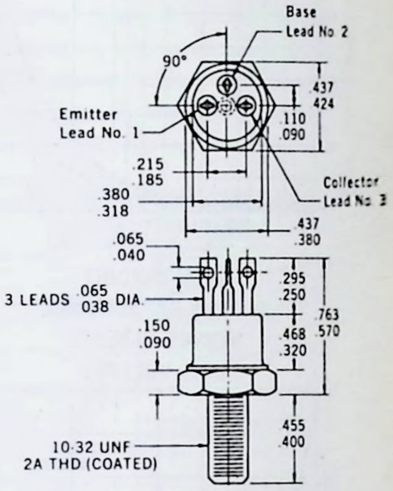
30 WATT NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* TRANSISTORS

SEE 2N4999 • 2N5001 FOR PNP COMPLEMENT

- **HIGH POWER - - 30 WATTS @ $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE - - 80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE - - 0.85 V (MAX) $V_{CE}(sat)$ @ $I_C = 2.0$ A**
- **HIGH FREQUENCY - - 50 AND 60 MHz (MIN) f_T**
- **BETA GUARANTEED @ 3 POINTS - - 50 mA, 1.0 A AND 2.0 A**
- **ISOLATED COLLECTOR PACKAGE - - NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
(in accordance with JEDEC TO-59 outline)



NOTES. All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$ V. (See Maximum Permissible Power Curve and Note 4)	30 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	80 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	2.0 Amps

ELECTRICAL CHARACTERISTICS (25° Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4998 MIN.	2N4998 TYP.	2N4998 MAX.	2N5000 MIN.	2N5000 TYP.	2N5000 MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**80**			**80**			**Volts**	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	100			100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**64**		**50**	**120**			$I_C = 50$ mA	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**63**	**90**	**70**	**110**	**200**		$I_C = 1.0$ A	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	45		35	63			$I_C = 1.0$ A	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**15**	**33**		**30**	**56**			$I_C = 2.0$ A	$V_{CE} = 5.0$ V
h_{fe}	**High Frequency Current Gain** ($f = 20$ MHz)	**2.5**	**3.8**		**3.0**	**4.3**			$I_C = 0.2$ A	$V_{CE} = 5.0$ V
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 3)		0.38	0.46		0.38	0.46	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
V_{CE}(sat)	**Pulsed Collector Saturation Voltage** (Note 3)		**0.75**	**0.85**		**0.75**	**0.85**	**Volts**	$I_C = 2.0$ A	$I_B = 0.2$ A

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild process

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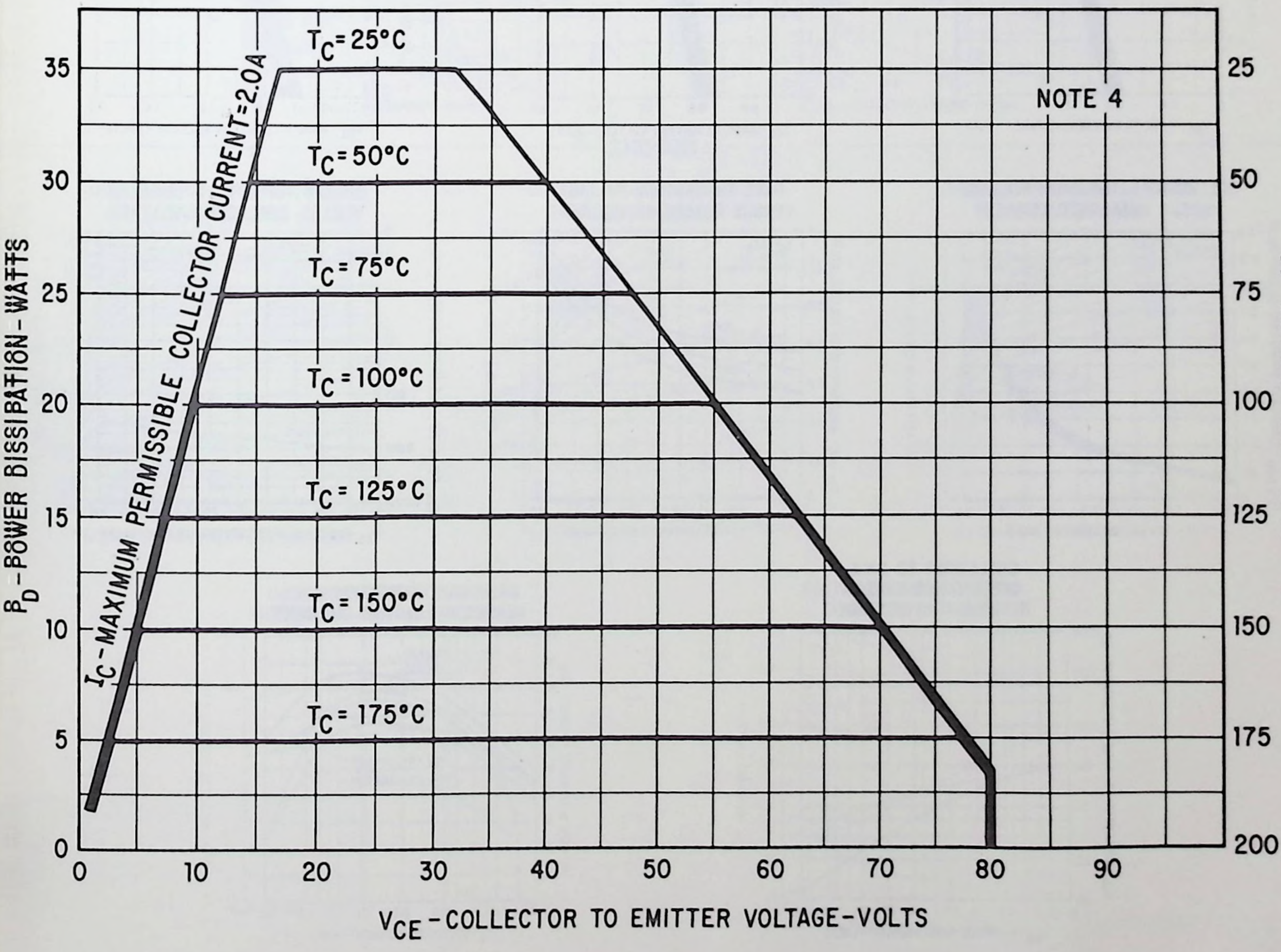
ELECTRICAL CHARACTERISTICS (25° Case Temperature unless otherwise noted)

		2N4998			2N5000					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 3)		0.98	1.2		0.98	1.2	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 3)		1.30	1.5		1.30	1.5	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
V_{BE}(on)	Pulsed Base Emitter "ON" Voltage (Note 3)			1.5			1.5	Volts	$I_C = 2.0$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		.002	1.0		.002	1.0	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = 60$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance		30	70		30	70	pF	$I_E = 0$	$V_{CB} = 10$ V

NOTES:

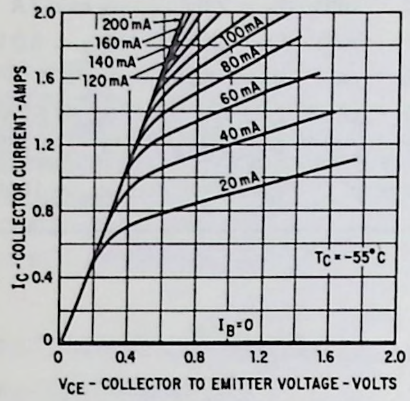
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

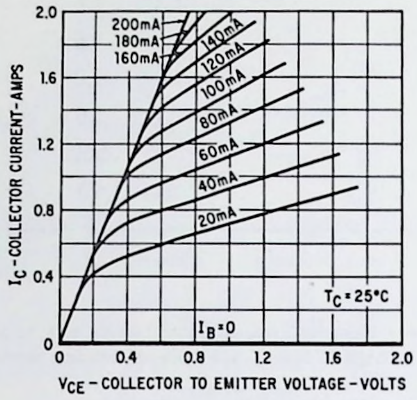


TYPICAL ELECTRICAL CHARACTERISTICS

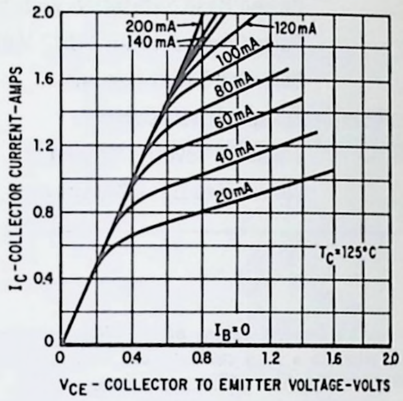
COLLECTOR CHARACTERISTICS* SATURATION REGION



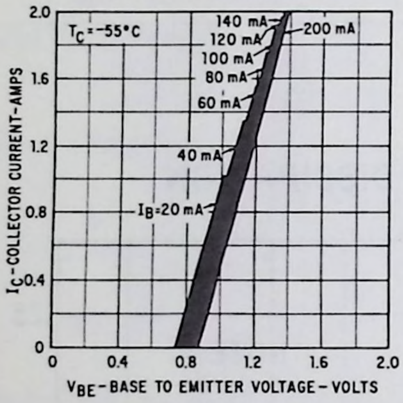
COLLECTOR CHARACTERISTICS* SATURATION REGION



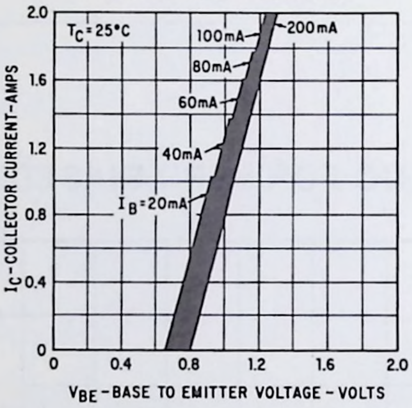
COLLECTOR CHARACTERISTICS* SATURATION REGION



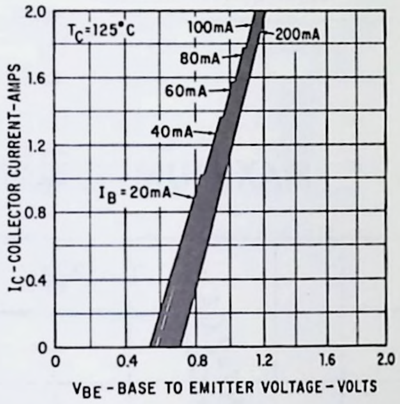
BASE CHARACTERISTICS*



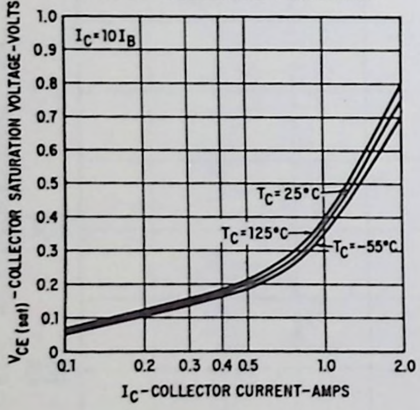
BASE CHARACTERISTICS*



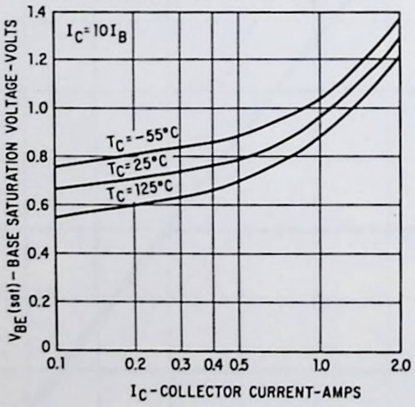
BASE CHARACTERISTICS*



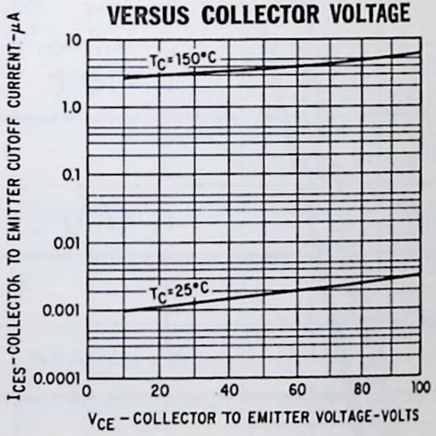
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



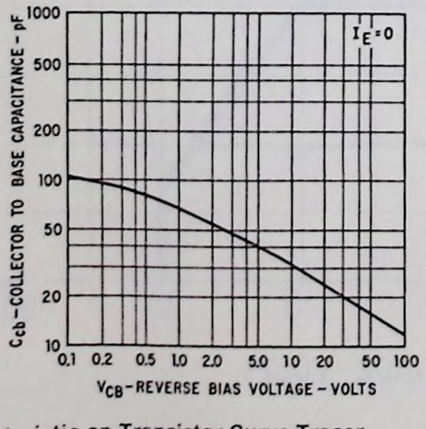
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



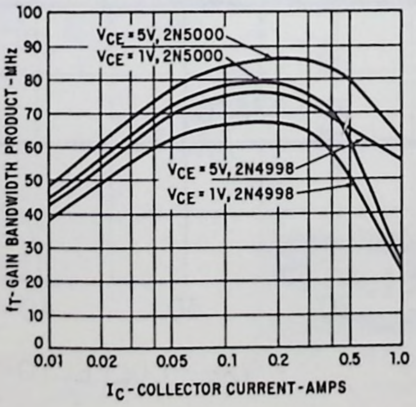
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

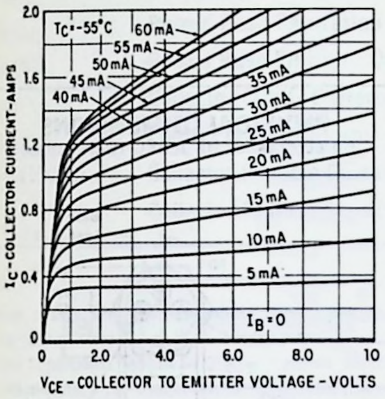


* Single family characteristic on Transistor Curve Tracer.

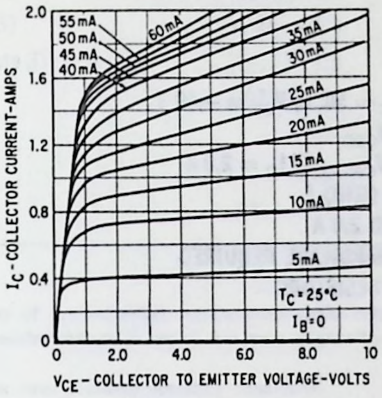
TYPICAL ELECTRICAL CHARACTERISTICS

2N4998

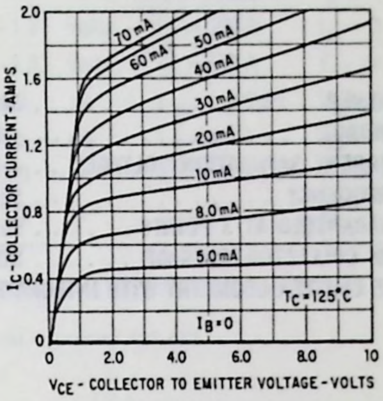
COLLECTOR CHARACTERISTICS* ACTIVE REGION



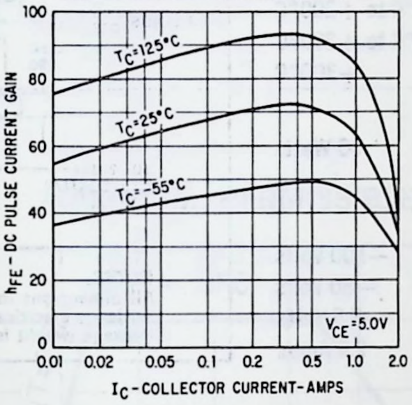
COLLECTOR CHARACTERISTICS* ACTIVE REGION



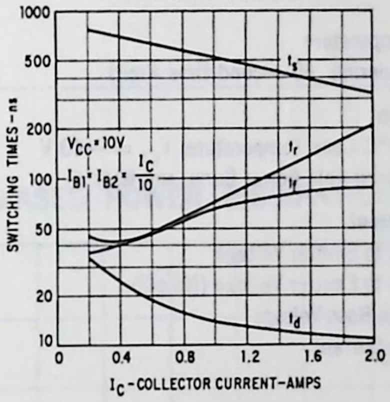
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

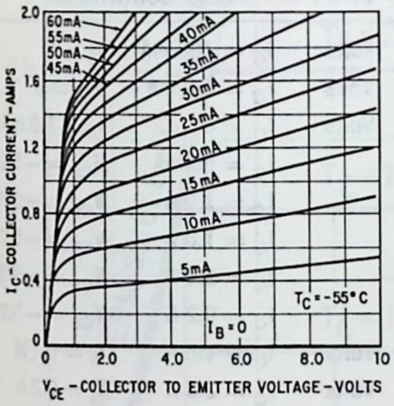


SWITCHING TIMES VERSUS COLLECTOR CURRENT

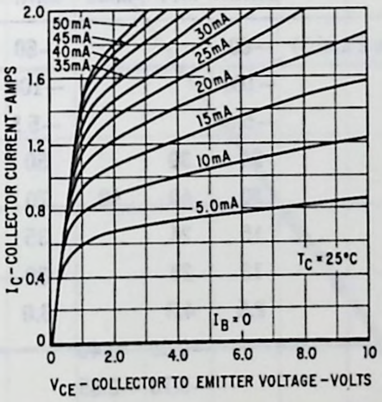


2N5000

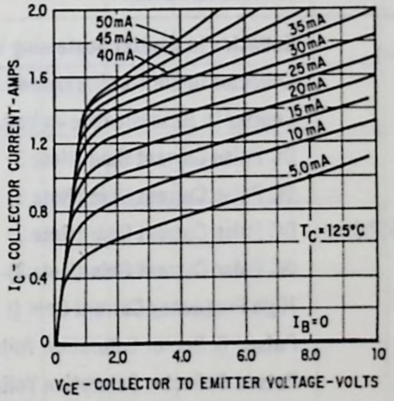
COLLECTOR CHARACTERISTICS* ACTIVE REGION



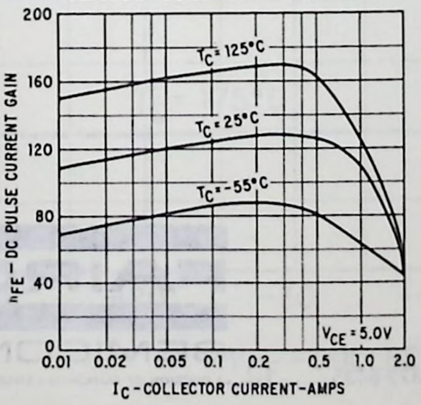
COLLECTOR CHARACTERISTICS* ACTIVE REGION



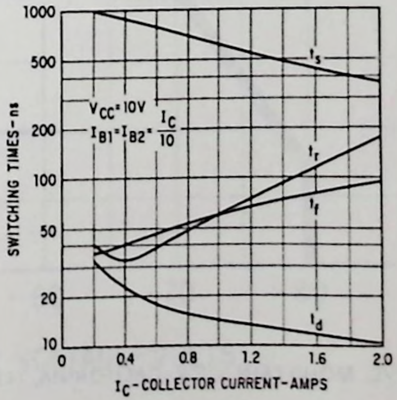
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT



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*Sinngle Family Characteristics on Transistor Curve Tracer.

2N4999 • 2N5001

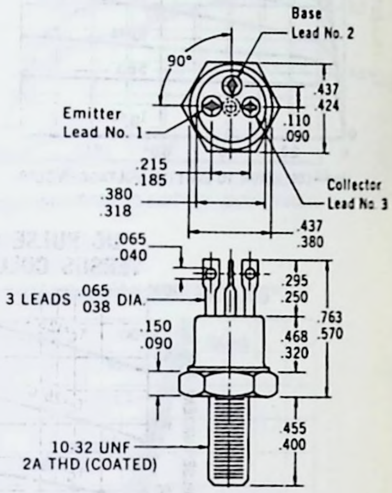
30 WATT PNP POWER TRANSISTORS

DIFFUSED SILICON PLANAR* TRANSISTORS

SEE 2N4998 • 2N5000 FOR NPN COMPLEMENT

- **HIGH POWER** . . . . 30 WATTS AT $T_C = 50°C$, $V_{CE} = -40$ V
- **HIGH VOLTAGE** . . . . −80 V (MIN) LV_{CEO}
- **HIGH CURRENT SATURATION VOLTAGE** . . . −0.85 V (MAX) $V_{CE(sat)}$ AT $I_C = 2.0$ A
- **HIGH FREQUENCY** . . . . 50 AND 60 MHz (MIN) f_T
- **BETA GUARANTEED AT 3 POINTS** . . . . . . 50 mA, 1.0 A AND 2.0 A
- **ISOLATED COLLECTOR PACKAGE** . . . . . . NO ISOLATING HARDWARE REQUIRED
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
(in accordance ith JEDEC TO-59 outline)



NOTES:
All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)		+300°C
Maximum Power Dissipation		
Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve and Note 4)		30 Watts
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	−80 Volts
V_{EBO}	Emitter to Base Voltage	−5.5 Volts
I_C	Collector Current	2.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N4999 MIN.	TYP.	MAX.	2N5001 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage (Notes 2 and 3)**	−80			−80			Volts	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−100			−100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.5			−5.5			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain (Note 3)**	20	39		50	85			$I_C = 50$ mA	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain (Note 3)**	30	40	90	70	88	200		$I_C = 1.0$ A	$V_{CE} = -5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	24		35	52			$I_C = 1.0$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain (Note 3)**	15	28		30	50			$I_C = 2.0$ A	$V_{CE} = -5.0$ V
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	2.5	4.8		3.0	6.1			$I_C = 0.2$ A	$V_{CE} = -5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		−0.38	−0.46		−0.38	−0.46	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 3)**		−0.73	−0.85		−0.73	−0.85	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild proces

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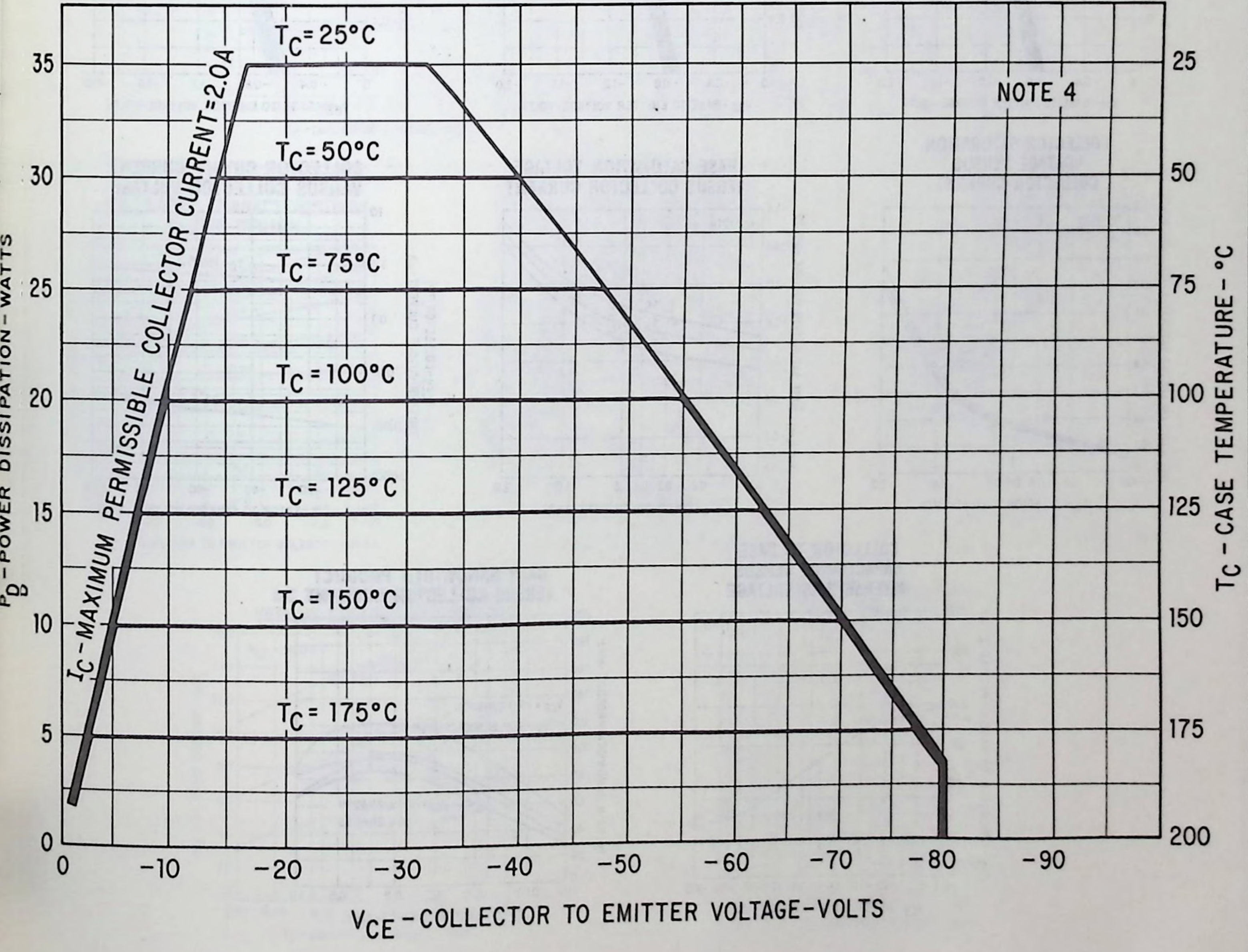
ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N4999 MIN.	2N4999 TYP.	2N4999 MAX.	2N5001 MIN.	2N5001 TYP.	2N5001 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−0.96	−1.2		−0.96	−1.2	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−1.28	−1.5		−1.28	−1.5	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
V_{BE}(on)	Pulsed Base Emitter "ON" Voltage (Note 3)			−1.5			−1.5	Volts	$I_C = 2.0$ A	$V_{CE} = -5.0$ V
I_{CES}	Collector Cutoff Current		.002	1.0		.002	1.0	µA	$V_{CE} = -60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	µA	$I_C = 0$	$V_{EB} = -4.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	µA	$V_{CE} = -60$ V	$V_{EB} = -2.0$ V
C_{cb}	Collector to Base Capacitance		46	120		46	120	pF	$I_E = 0$	$V_{CB} = -10$ V

NOTES:

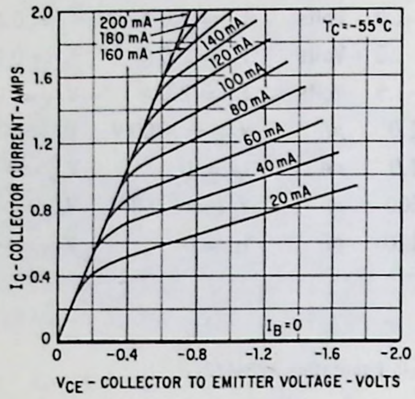
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
3. Pulse Conditions: length = 300 µs; duty cycle = 1%.
4. Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

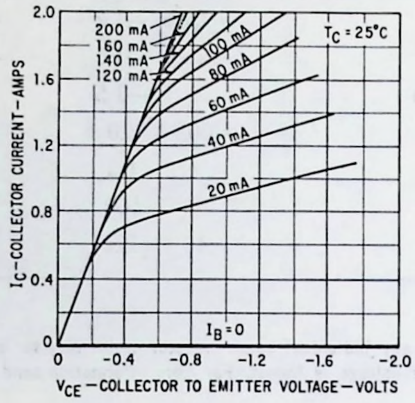


TYPICAL ELECTRICAL CHARACTERISTICS

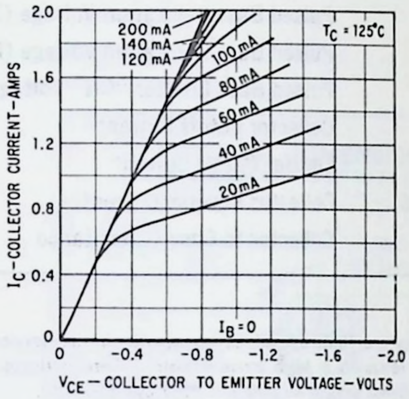
COLLECTOR CHARACTERISTICS° SATURATION REGION



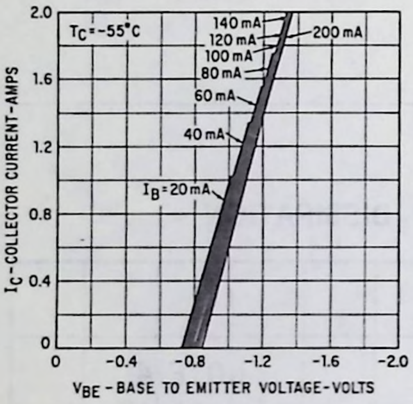
COLLECTOR CHARACTERISTICS° SATURATION REGION



COLLECTOR CHARACTERISTICS° SATURATION REGION



BASE CHARACTERISTICS°



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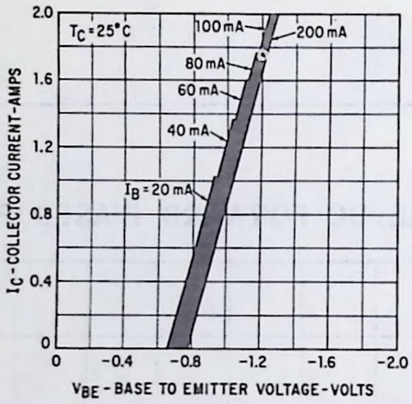
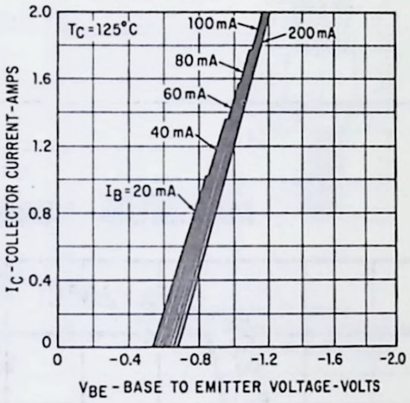
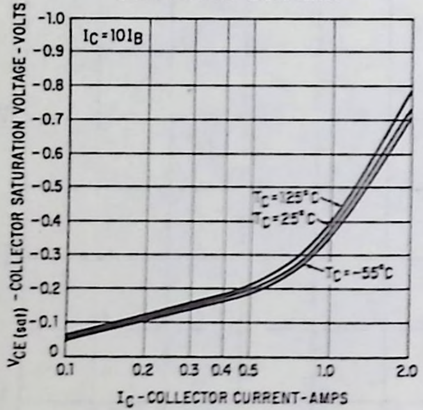


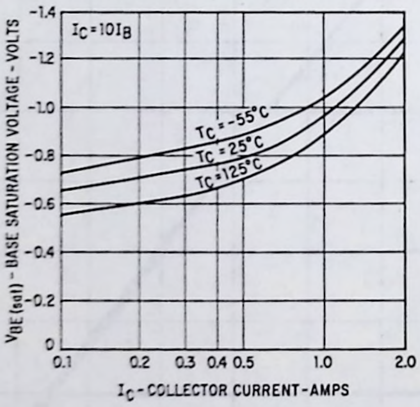
BASE CHARACTERISTICS°



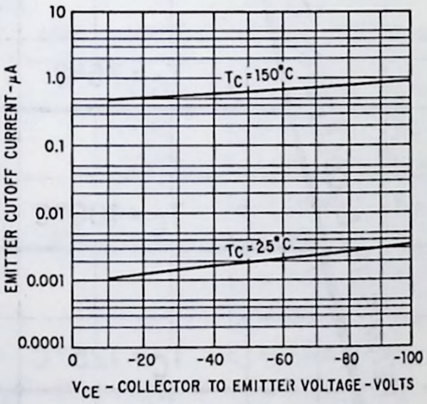
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



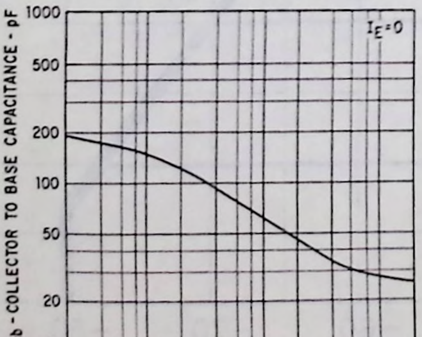
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



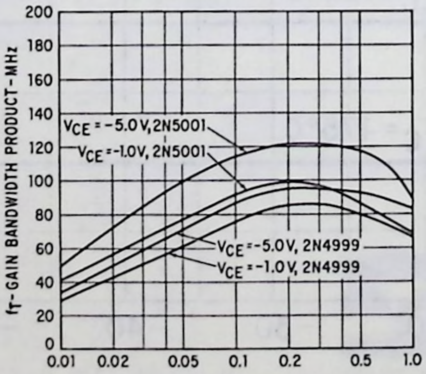
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

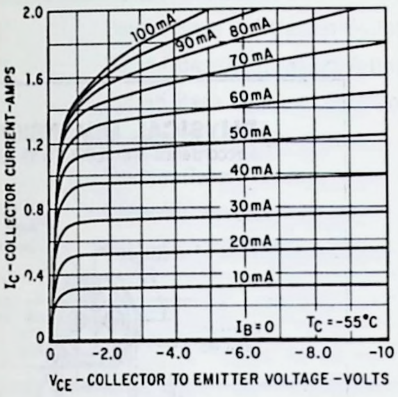


° Single family characteristic on Transistor Curve Tracer.

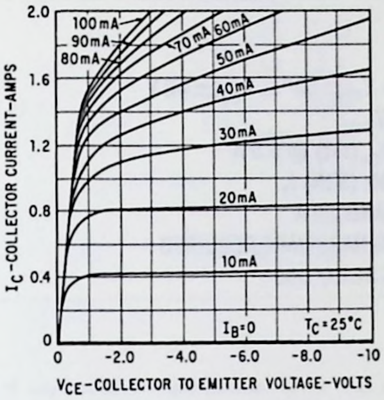
TYPICAL ELECTRICAL CHARACTERISTICS

2N4999

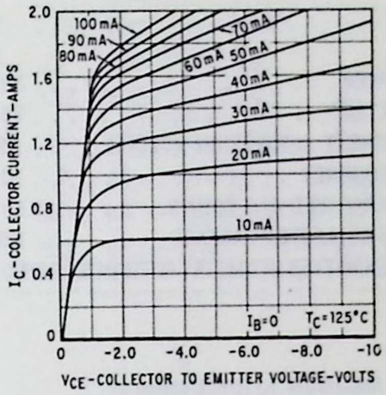
COLLECTOR CHARACTERISTICS* ACTIVE REGION



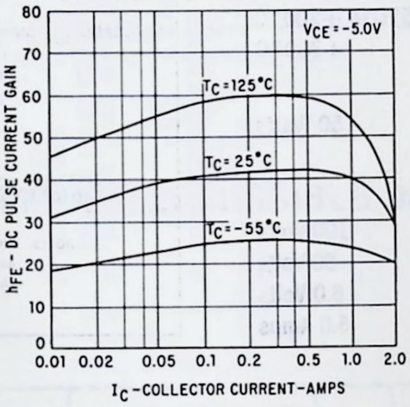
COLLECTOR CHARACTERISTICS* ACTIVE REGION



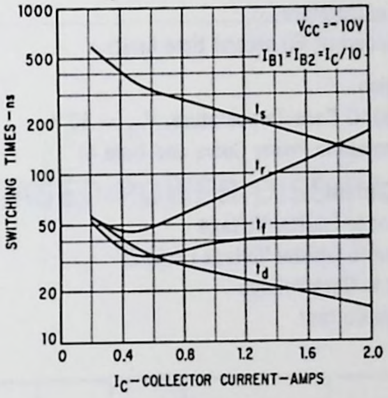
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

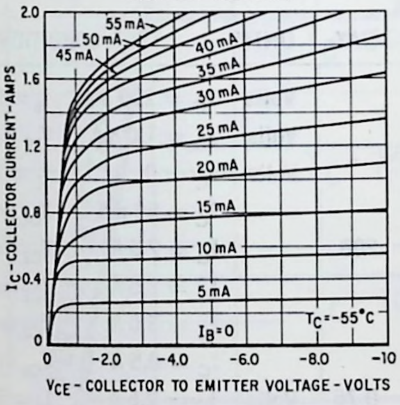


SWITCHING TIMES VERSUS COLLECTOR CURRENT

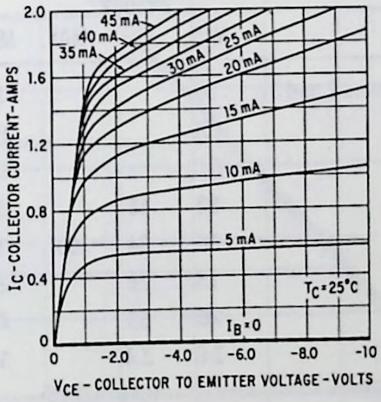


2N5001

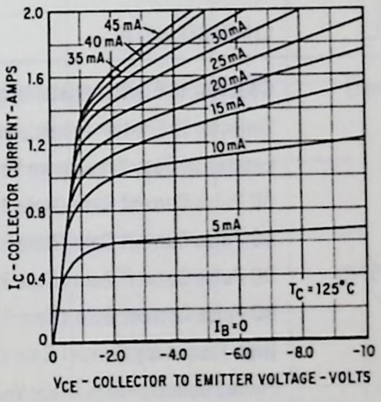
COLLECTOR CHARACTERISTICS* ACTIVE REGION



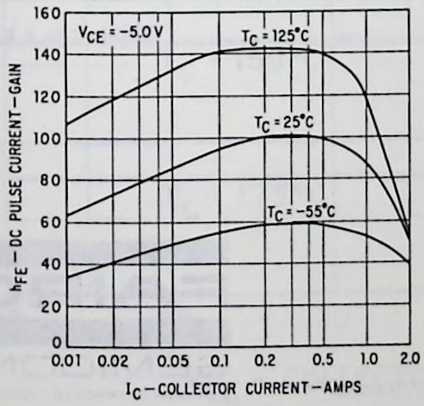
COLLECTOR CHARACTERISTICS* ACTIVE REGION



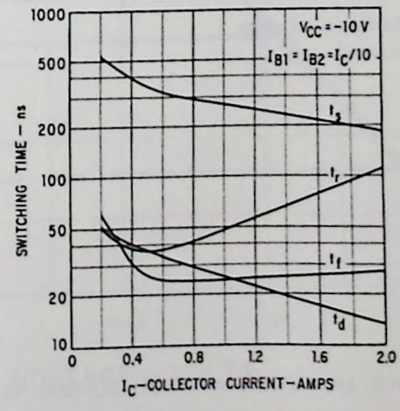
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT



* Single family characteristic on Transistor Curve Tracer.

2N5002 • 2N5004

50 WATT NPN POWER TRANSISTORS

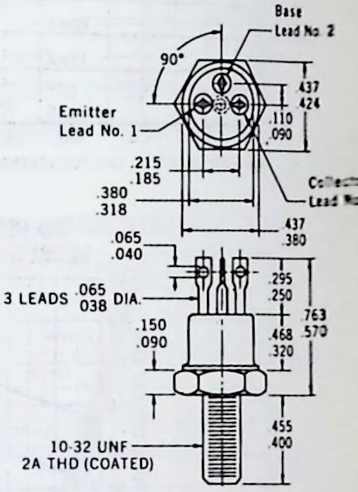
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5003 • 2N5005 FOR PNP COMPLEMENT

- **HIGH POWER . . . . 50 WATTS @ $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE . . . . 80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . . 1.5 V (MAX) $V_{CE}(sat)$ @ 5.0 A**
- **HIGH FREQUENCY . . . . 60 AND 70 MHz (MIN) f_T**
- **BETA GUARANTEED @ 3 POINTS . . . . 50 mA, 2.5 A AND 5.0 A**
- **ISOLATED COLLECTOR PACKAGE . . . . NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS

(in accordance with JEDEC TO-59 outline)



NOTES: All dimensions in inches
All leads electrically isolated from ca
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$ V (See Maximum Permissible Power Curve and Note 4)	50 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	80 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	5.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N5002			2N5004					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**80**			**80**			**Volts**	**$I_C = 100$ mA**	**$I_B = 0$**
BV_{CES}	Collector to Emitter Breakdown Voltage	100			100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**46**		**50**	**100**			**$I_C = 50$ mA**	**$V_{CE} = 5.0$ V**
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**64**	**90**	**70**	**114**	**200**		**$I_C = 2.5$ A**	**$V_{CE} = 5.0$ V**
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	26		35	50			$I_C = 2.5$ A	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**53**		**40**	**65**			**$I_C = 5.0$ A**	**$V_{CE} = 5.0$ V**
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**3.0**	**3.4**		**3.5**	**4.4**			**$I_C = 0.5$ A**	**$V_{CE} = 5.0$ V**
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 3)		0.43	0.75		0.43	0.75	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{CE}(sat)$	**Pulsed Collector Saturation Voltage** (Note 3)		**0.85**	**1.5**		**0.85**	**1.5**	**Volts**	**$I_C = 5.0$ A**	**$I_B = 0.5$ A**

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild proc

FAIRCHILD
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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

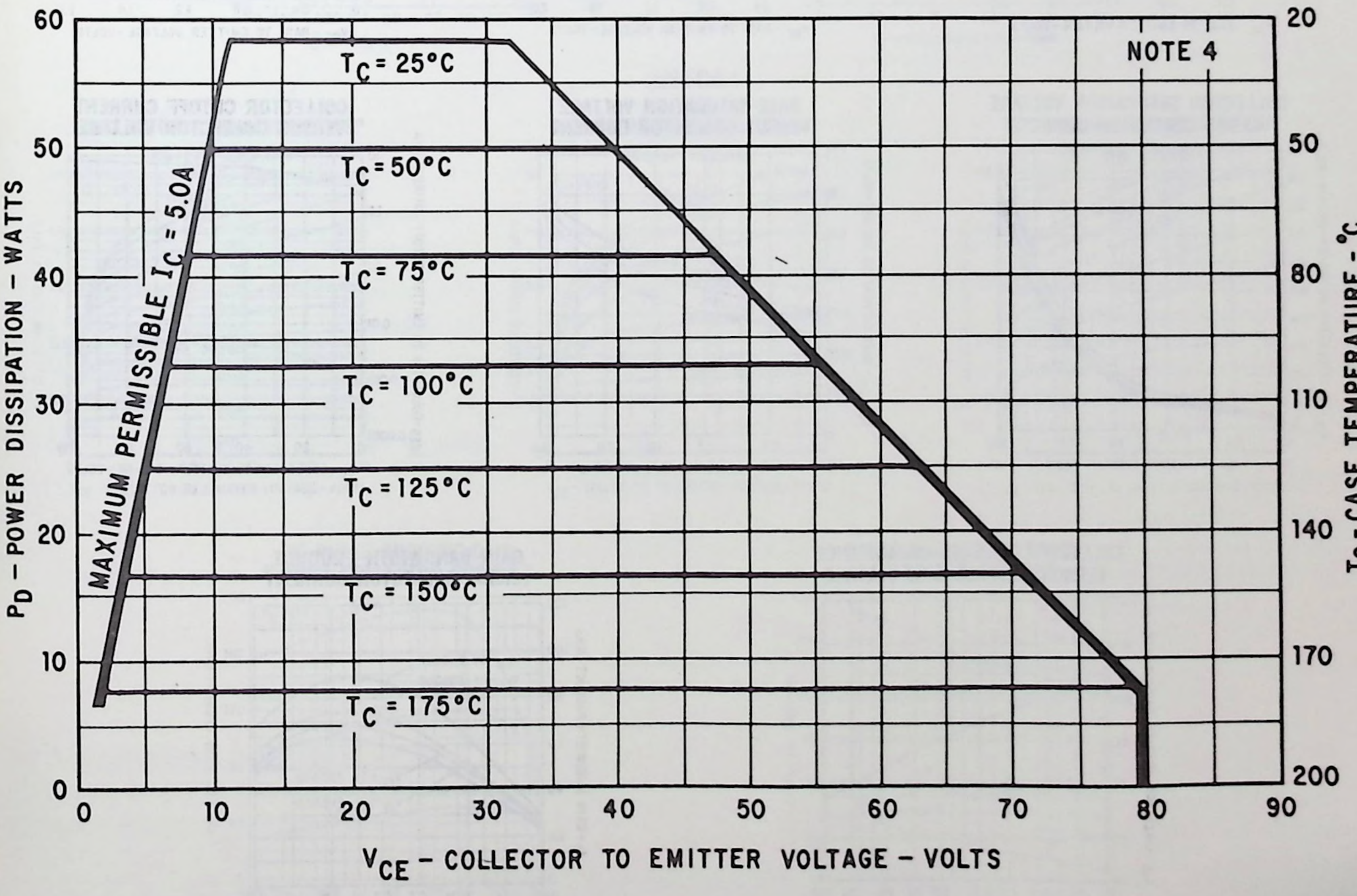
ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5002 MIN.	2N5002 TYP.	2N5002 MAX.	2N5004 MIN.	2N5004 TYP.	2N5004 MAX.	UNITS	TEST CONDITIONS	
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 3)		1.16	1.45		1.16	1.45	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 3)		1.50	2.2		1.50	2.2	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
V_{BE}(on)	Pulsed Base Emitter "ON" Voltage (Note 3)			1.45			1.45	Volts	$I_C = 2.5$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		0.007	1.0		0.007	1.0	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = 60$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance		90	250		90	250	pF	$I_E = 0$	$V_{CB} = 10$ V

NOTES:

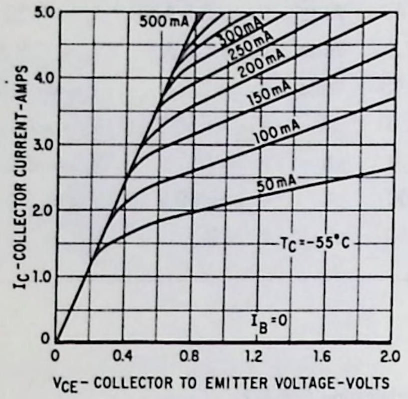
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

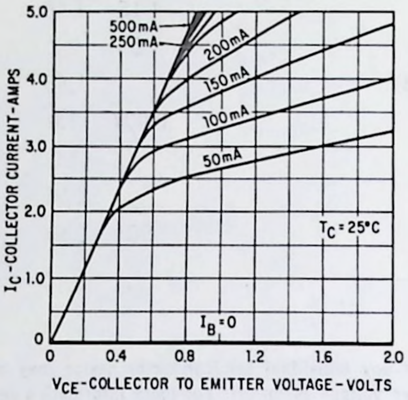


TYPICAL ELECTRICAL CHARACTERISTICS

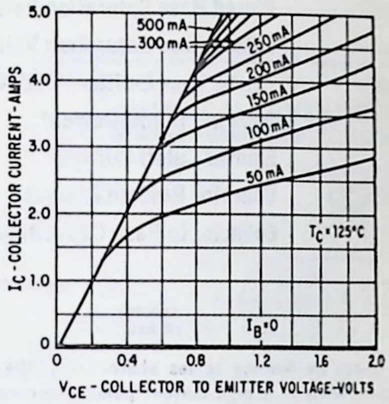
COLLECTOR CHARACTERISTICS* SATURATION REGION



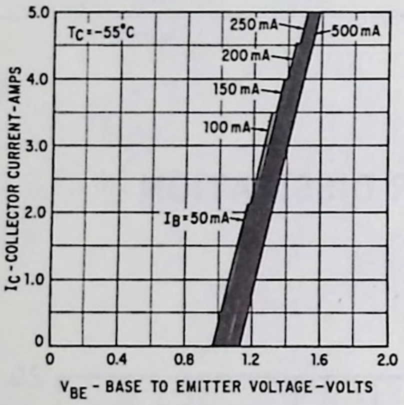
COLLECTOR CHARACTERISTICS* SATURATION REGION



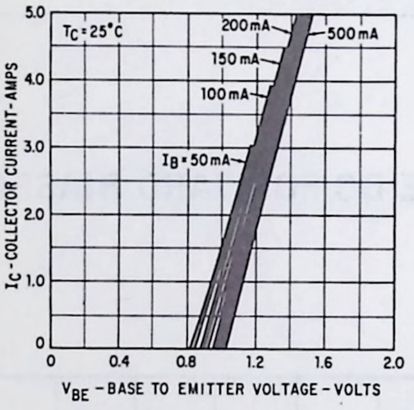
COLLECTOR CHARACTERISTICS* SATURATION REGION



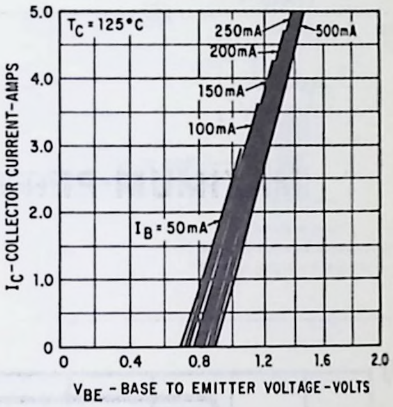
BASE CHARACTERISTICS*



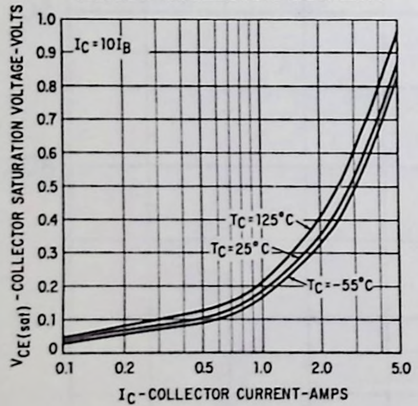
BASE CHARACTERISTICS*



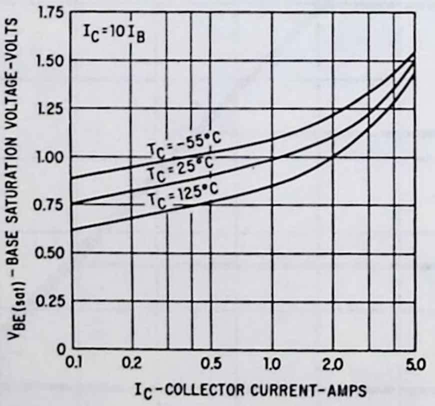
BASE CHARACTERISTICS*



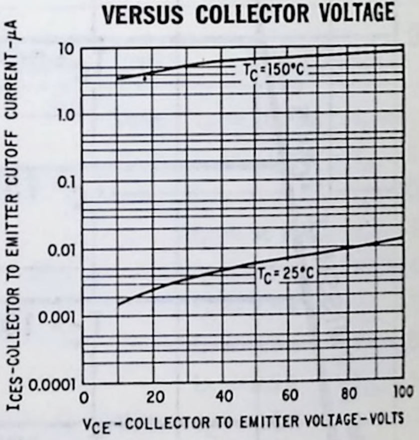
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



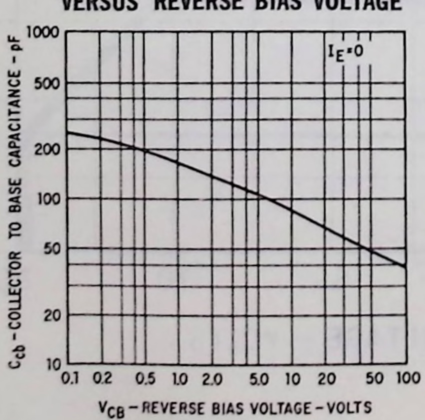
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



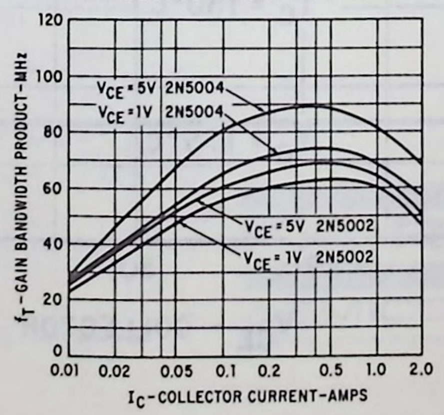
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

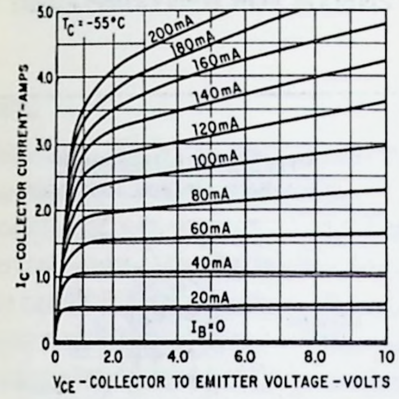


*Single Family Characteristics on Transistor Curve Tracer.

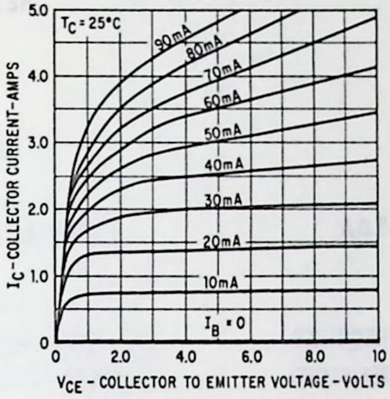
TYPICAL ELECTRICAL CHARACTERISTICS

2N5002

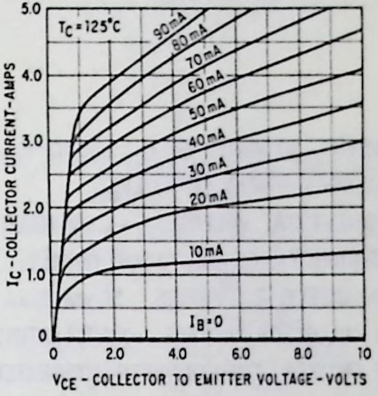
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



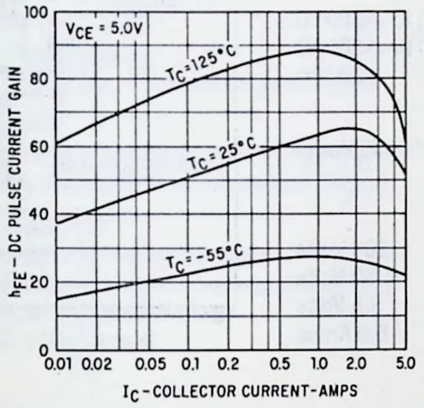
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



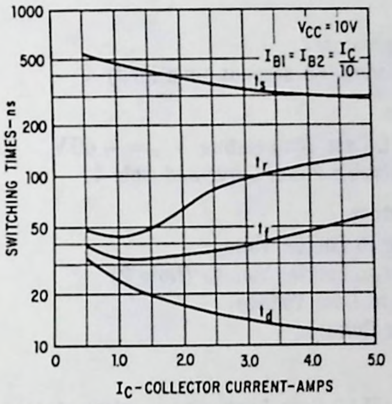
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT

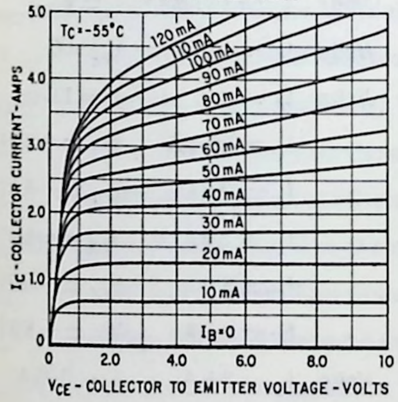


SWITCHING TIMES VERSUS
COLLECTOR CURRENT

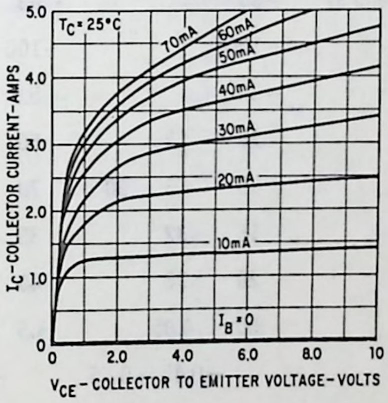


2N5004

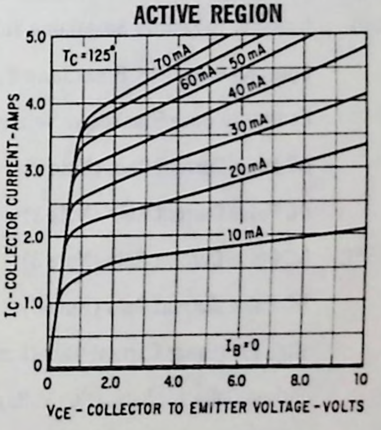
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



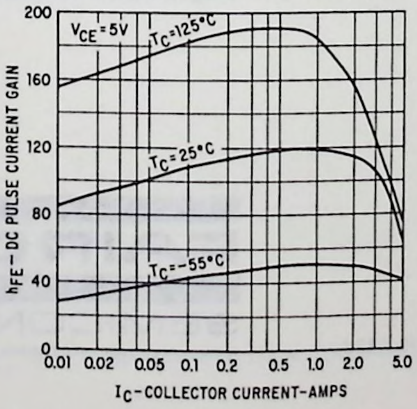
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



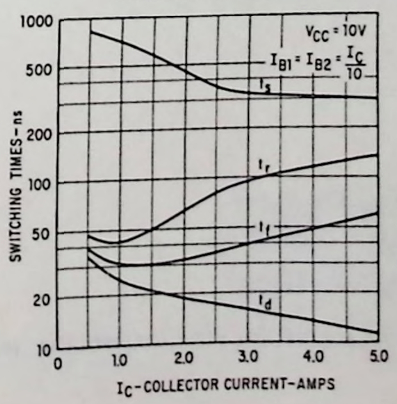
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS
COLLECTOR CURRENT



*Single Family Characteristics on Transistor Curve Tracer.

2N5003 · 2N5005

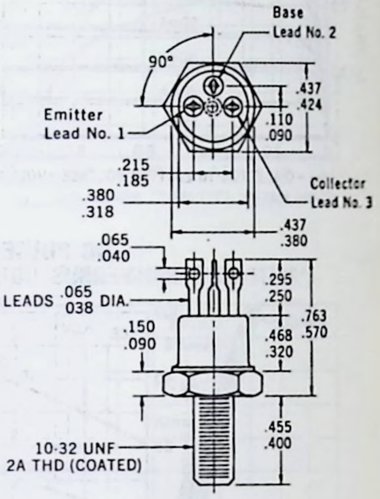
50 WATT PNP POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5002 · 2N5004 FOR NPN COMPLEMENT

PHYSICAL DIMENSIONS

(in accordance with JEDEC TO-59 outline)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

FEATURES

- **HIGH POWER - - 50 WATTS @ $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE - - −80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SAT. VOLTAGE - - −1.5 V (MAX) $V_{CE}(sat)$ @ 5.0 A**
- **HIGH FREQUENCY - - 60 AND 70 MHz (MIN) f_T**
- **BETA GUARANTEED @ 3 POINTS - - 50 mA, 2.5 A AND 5.0 A**
- **ISOLATED COLLECTOR PACKAGE - - NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve and Note 4)	50 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	− 80 Volts
V_{EBO}	Emitter to Base Voltage	− 5.5 Volts
I_C	Collector Current	5.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5003 MIN.	TYP.	MAX.	2N5005 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	−80			−80			Volts	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−100			−100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.5			−5.5			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	20	52		50	133			$I_C = 50$ mA	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	30	50	90	70	114	200		$I_C = 2.5$ A	$V_{CE} = -5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	32		35	90			$I_C = 2.5$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	20	38		40	77			$I_C = 5.0$ A	$V_{CE} = -5.0$ V
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	3.0	4.05		3.5	4.85			$I_C = 0.5$ A	$V_{CE} = -5.0$ V
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 3)		−0.45	−0.75		−0.45	−0.75	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{CE}(sat)$	**Pulsed Collector Saturation Voltage** (Note 3)		−0.9	−1.5		−0.9	−1.5	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process.

FAIRCHILD
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2N5003 · 2N5005

50 WATT PNP POWER TRANSISTORS

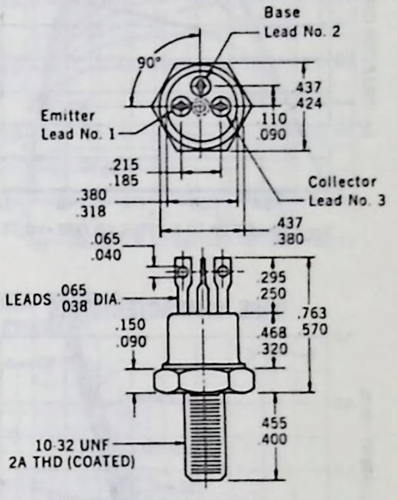
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5002 • 2N5004 FOR NPN COMPLEMENT

EATURES

- **HIGH POWER - - 50 WATTS @ $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE - - −80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SAT. VOLTAGE - - −1.5 V (MAX) $V_{CE}(sat)$ @ 5.0 A**
- **HIGH FREQUENCY - - 60 AND 70 MHz (MIN) f_T**
- **BETA GUARANTEED @ 3 POINTS - - 50 mA, 2.5 A AND 5.0 A**
- **SOLATED COLLECTOR PACKAGE - - NO ISOLATING HARDWARE REQUIRED**
- **ISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
(in accordance with JEDEC TO-59 outline)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve and Note 4)	50 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	− 80 Volts
V_{EBO}	Emitter to Base Voltage	− 5.5 Volts
I_C	Collector Current	5.0 Amps

LECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5003 MIN.	2N5003 TYP.	2N5003 MAX.	2N5005 MIN.	2N5005 TYP.	2N5005 MAX.	UNITS	TEST CONDITIONS	
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage (Notes 2 and 3)**	**−80**			**−80**			**Volts**	**$I_C = 100$ mA**	**$I_B = 0$**
BV_{CES}	Collector to Emitter Breakdown Voltage	−100			−100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.5			−5.5			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain (Note 3)**	**20**	**52**		**50**	**133**			**$I_C = 50$ mA**	**$V_{CE} = -5.0$ V**
h_{FE}	**DC Pulse Current Gain (Note 3)**	**30**	**50**	**90**	**70**	**114**	**200**		**$I_C = 2.5$ A**	**$V_{CE} = -5.0$ V**
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	32		35	90			$I_C = 2.5$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain (Note 3)**	**20**	**38**		**40**	**77**			**$I_C = 5.0$ A**	**$V_{CE} = -5.0$ V**
h_{fe}	**High Frequency Current Gain ($f = 20$ MHz)**	**3.0**	**4.05**		**3.5**	**4.85**			**$I_C = 0.5$ A**	**$V_{CE} = -5.0$ V**
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 3)		−0.45	−0.75		−0.45	−0.75	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
V_{CE}(sat)	**Pulsed Collector Saturation Voltage (Note 3)**		**−0.9**	**−1.5**		**−0.9**	**−1.5**	**Volts**	**$I_C = 5.0$ A**	**$I_B = 0.5$ A**

dditional Electrical Characteristics on page 2

*Planar is a patented Fairchild process.

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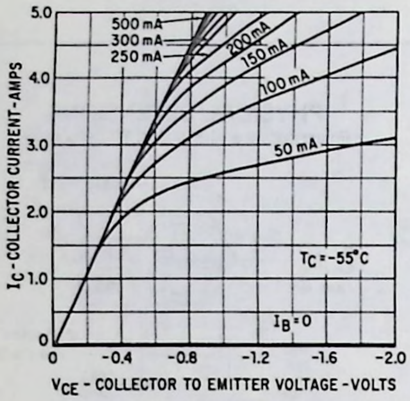
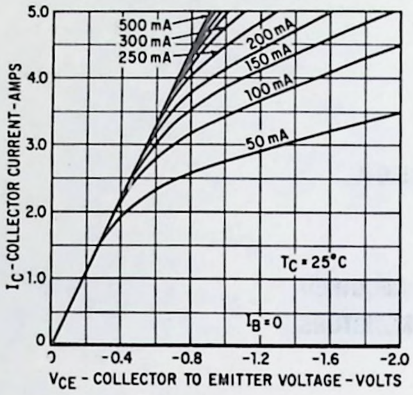
TYPICAL ELECTRICAL CHARACTERISTICS

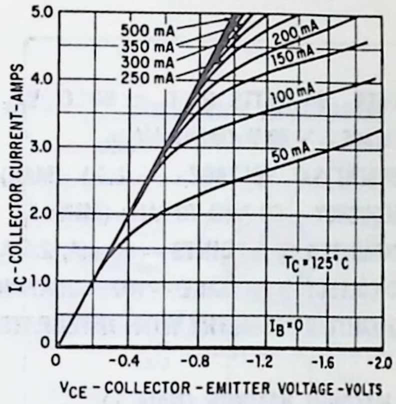
COLLECTOR CHARACTERISTICS SATURATION REGION



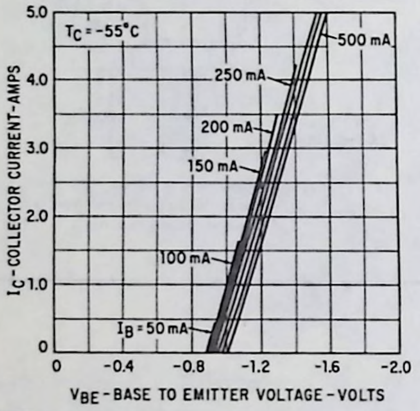
COLLECTOR CHARACTERISTICS SATURATION REGION



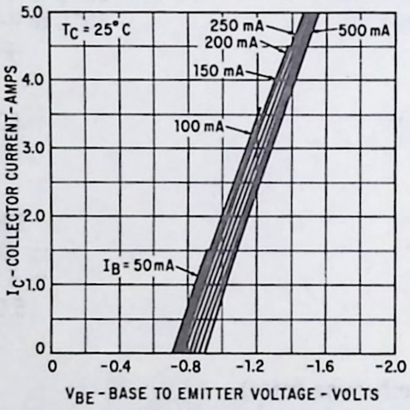
COLLECTOR CHARACTERISTICS SATURATION REGION



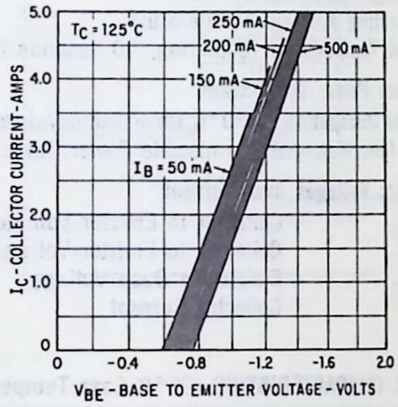
BASE CHARACTERISTICS



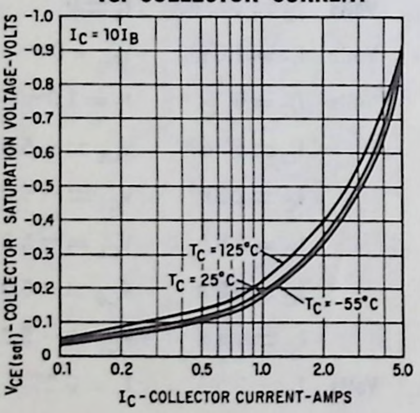
BASE CHARACTERISTICS



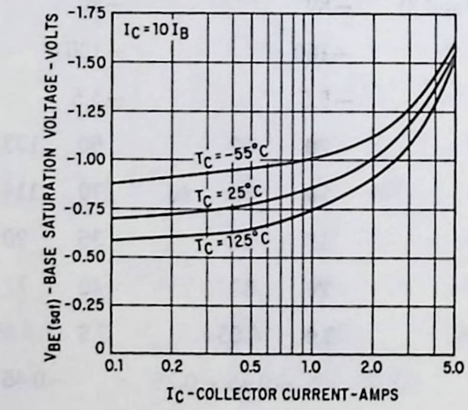
BASE CHARACTERISTICS



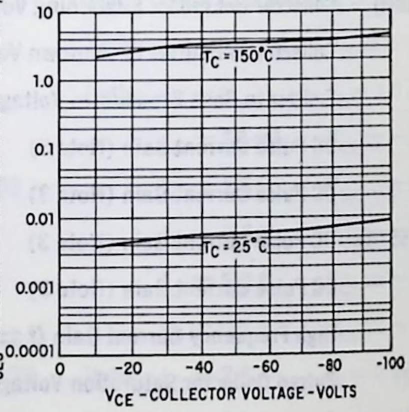
COLLECTOR SATURATION VOLTAGE VS. COLLECTOR CURRENT



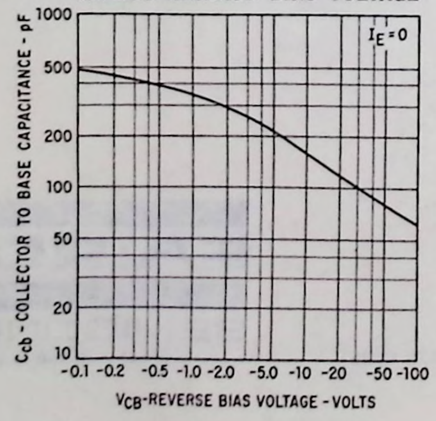
BASE SATURATION VOLTAGE VS. COLLECTOR CURRENT



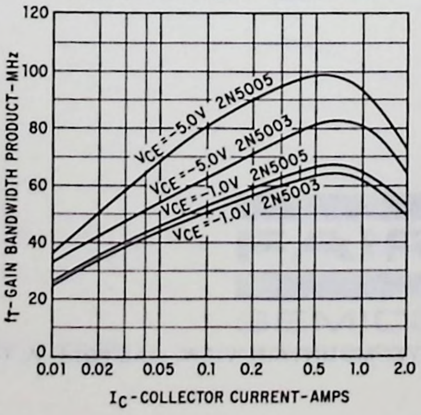
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



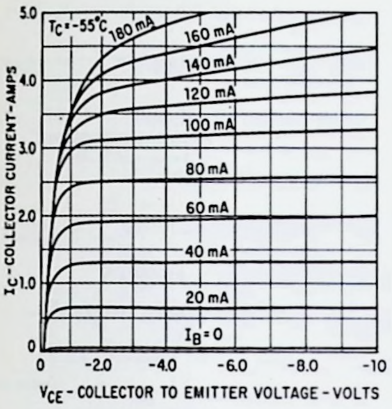
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



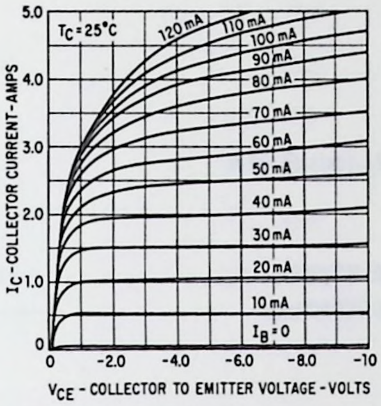
TYPICAL ELECTRICAL CHARACTERISTICS

2N5003

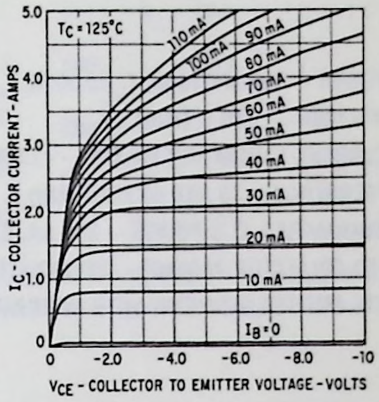
COLLECTOR CHARACTERISTICS



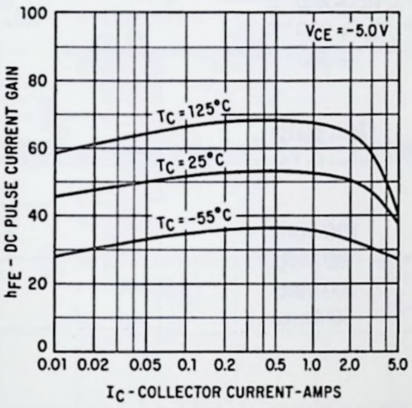
COLLECTOR CHARACTERISTICS



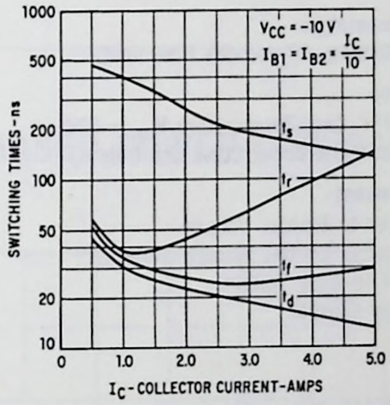
COLLECTOR CHARACTERISTICS



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

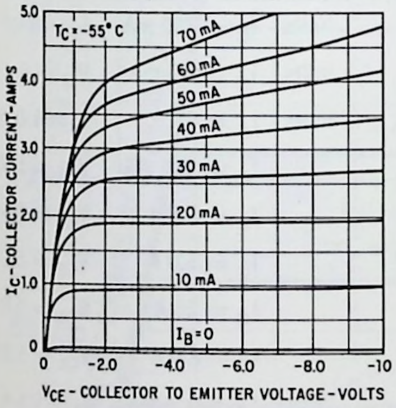


SWITCHING TIMES VERSUS COLLECTOR CURRENT

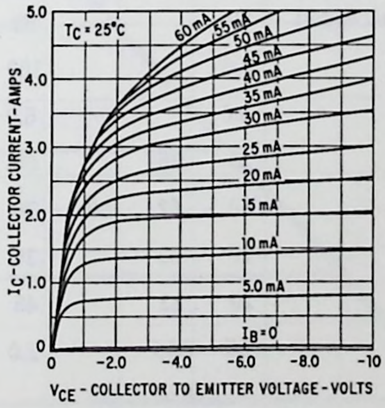


2N5005

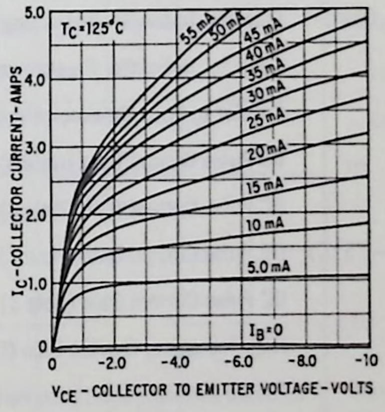
COLLECTOR CHARACTERISTICS



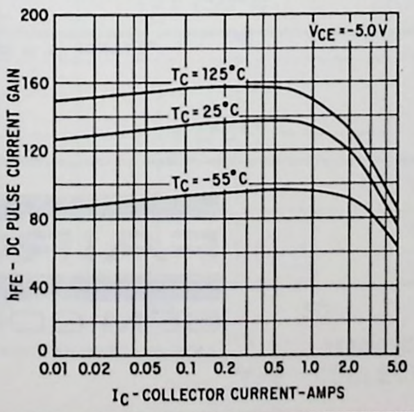
COLLECTOR CHARACTERISTICS



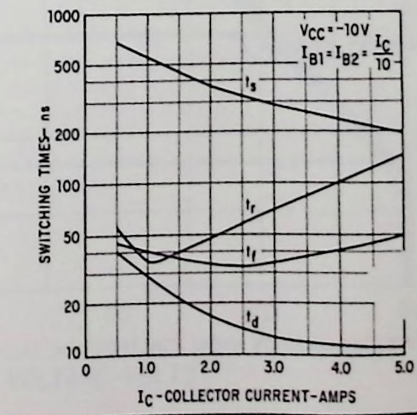
COLLECTOR CHARACTERISTICS



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT



2N5006 · 2N5008

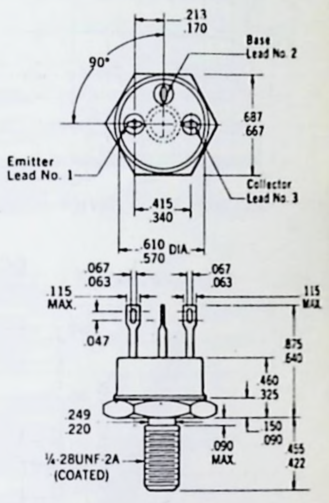
100 WATT NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5007 • 2N5009 FOR PNP COMPLEMENT

- **HIGH POWER - - 100 WATTS @ $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE - - 80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE - - 1.5 VOLTS (MAX) $V_{CE}(sat)$ @ 10 A**
- **HIGH FREQUENCY - - 30 AND 40 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS - - 100 mA, 5.0 A AND 10 A**
- **ISOLATED COLLECTOR PACKAGE - - NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
Similar to JEDEC (TO-61)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 14.1 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$V (See Maximum Permissible Power Curve and Note 4)	**100 Watts**

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	80 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	10 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5006 MIN.	2N5006 TYP.	2N5006 MAX.	2N5008 MIN.	2N5008 TYP.	2N5008 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**80**			**80**			**Volts**	**$I_C = 200$ mA**	**$I_B = 0$**
BV_{CES}	Collector to Emitter Breakdown Voltage	100			100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**35**		**50**	**95**			**$I_C = 100$ mA**	**$V_{CE} = 5.0$ V**
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**42**	**90**	**70**	**108**	**200**		**$I_C = 5.0$ A**	**$V_{CE} = 5.0$ V**
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	12	18		35	51			$I_C = 5.0$ A	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**33**		**45**	**91**			**$I_C = 10$ A**	**$V_{CE} = 5.0$ V**
h_{fe}	**High Frequency Current Gain** ($f = 20$ MHz)	**1.5**	**2.05**		**2.0**	**2.8**			**$I_C = 2.0$ A**	**$V_{CE} = 5.0$ V**
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 3)		0.55	0.9		0.55	0.9	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{CE}(sat)$	**Pulsed Collector Saturation Voltage** (Note 3)		**1.1**	**1.5**		**1.1**	**1.5**	**Volts**	**$I_C = 10$ A**	**$I_B = 1.0$ A**

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process

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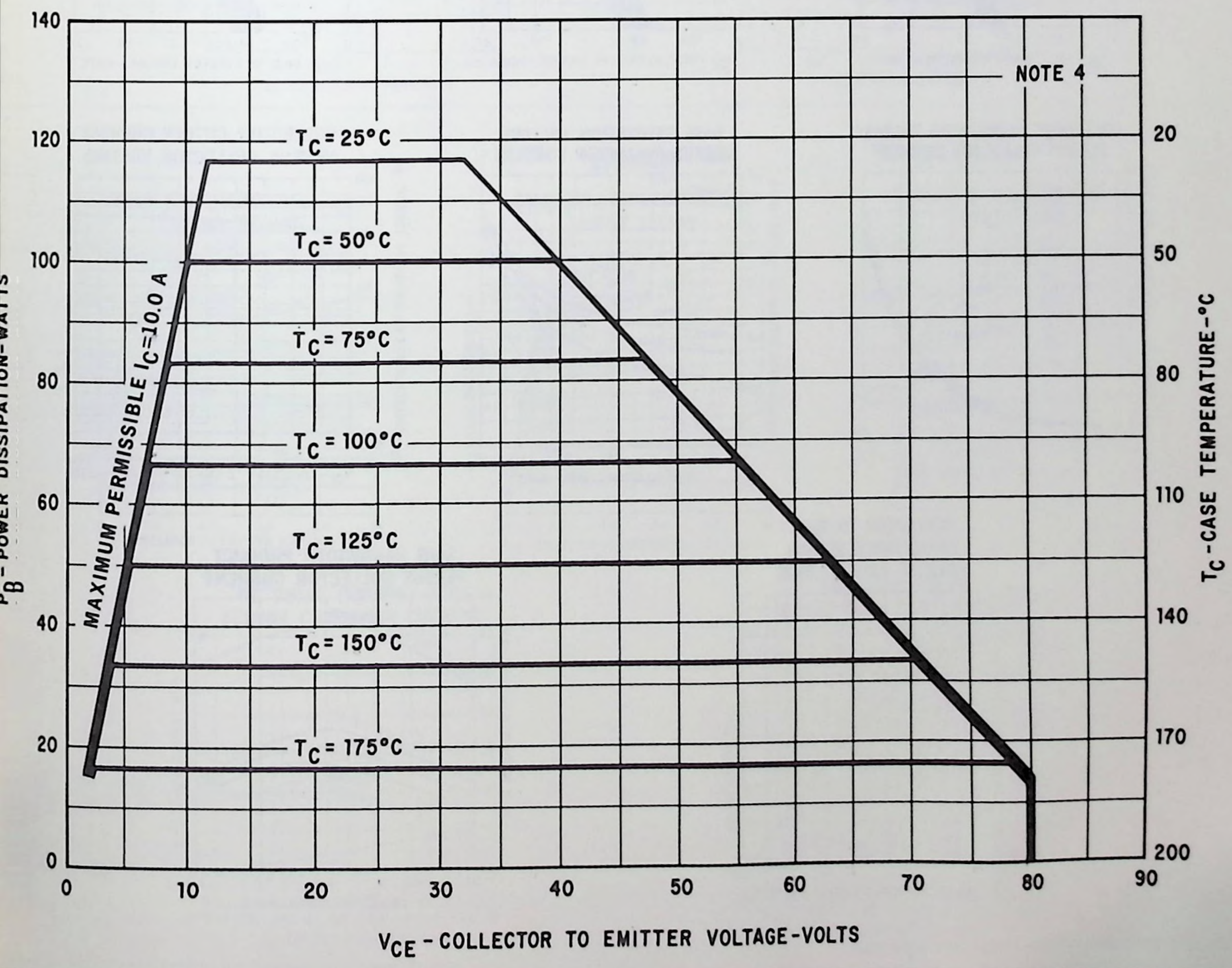
LECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5006 MIN.	2N5006 TYP.	2N5006 MAX.	2N5008 MIN.	2N5008 TYP.	2N5008 MAX.	UNITS	TEST CONDITIONS	
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 3)		1.2	1.8		1.2	1.8	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE}(sat)$	Pulsed Base Saturation Voltage (Note 3)		1.7	2.2		1.7	2.2	Volts	$I_C = 10$ A	$I_B = 1.0$ A
$V_{BE}(on)$	Pulsed Base Emitter "ON" Voltage (Note 3)			1.8			1.8	Volts	$I_C = 5.0$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		0.014	1.0		0.014	1.0	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = 5.0$ V
$I_{CEX}(150°C)$	Collector Reverse Current			500			500	μA	$V_{CE} = 60$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		235	275		235	275	pF	$I_E = 0$	$V_{CB} = 10$ V

NOTES:

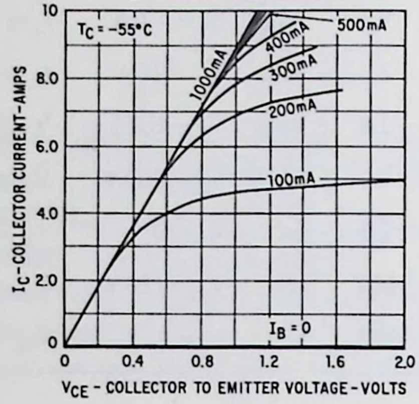
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

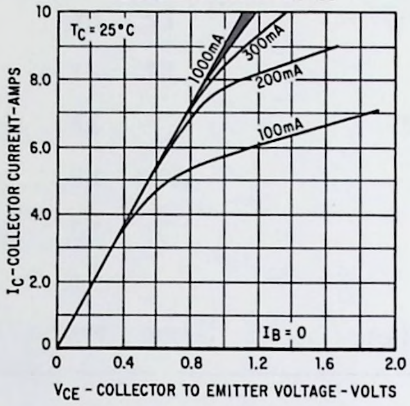


TYPICAL ELECTRICAL CHARACTERISTICS

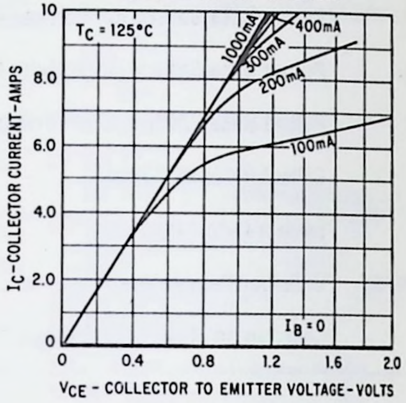
COLLECTOR CHARACTERISTICS* SATURATION REGION



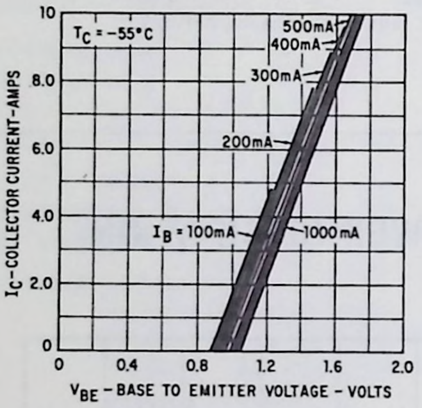
COLLECTOR CHARACTERISTICS* SATURATION REGION



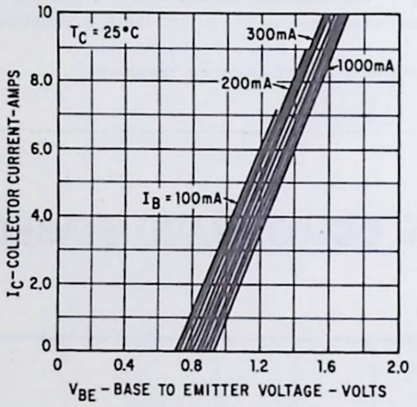
COLLECTOR CHARACTERISTICS* SATURATION REGION



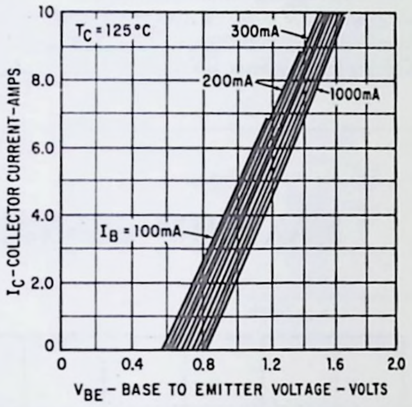
BASE CHARACTERISTICS*



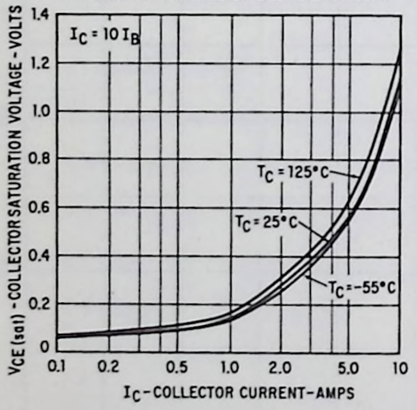
BASE CHARACTERISTICS*



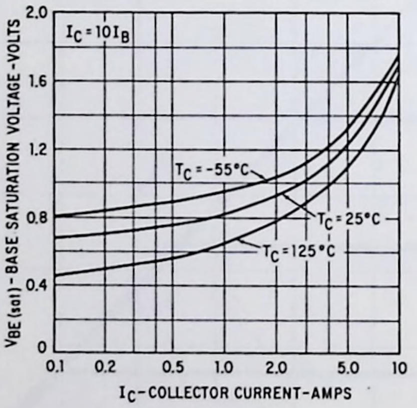
BASE CHARACTERISTICS*



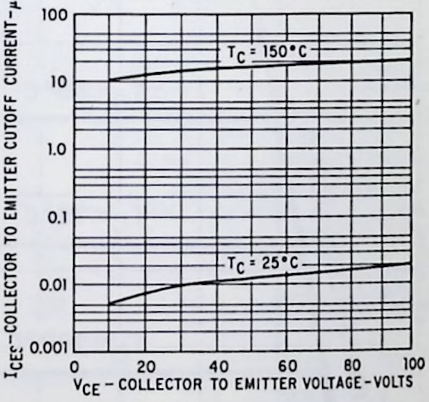
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



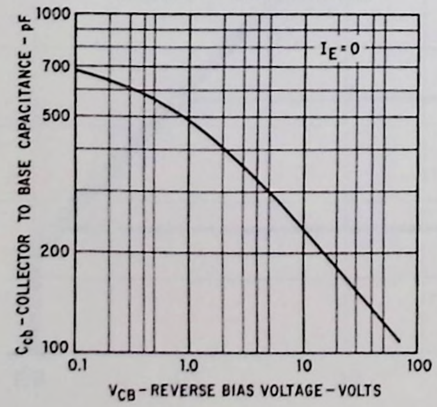
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



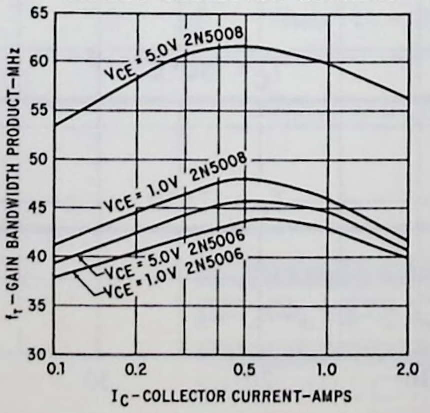
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

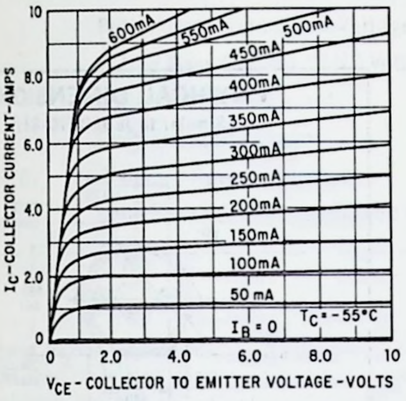


* Single family characteristics on transistor curve tracer.

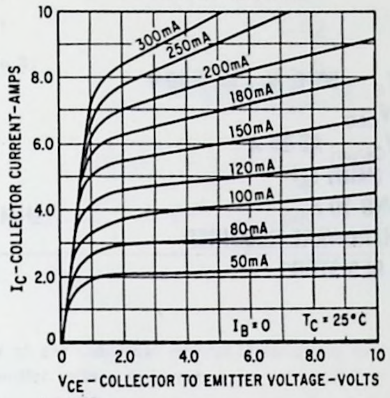
TYPICAL ELECTRICAL CHARACTERISTICS

2N5006

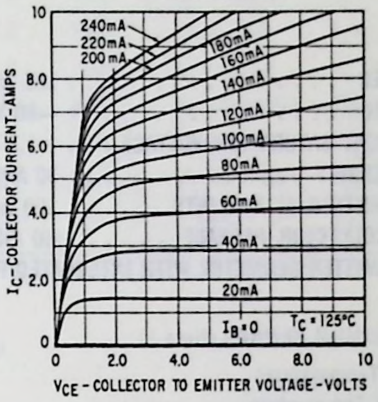
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



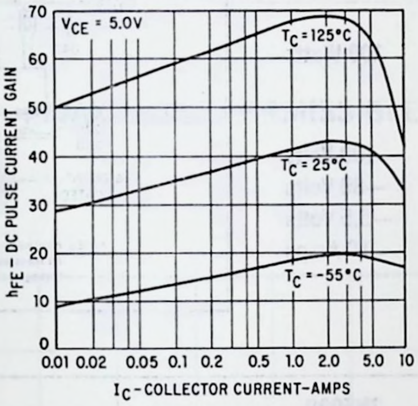
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



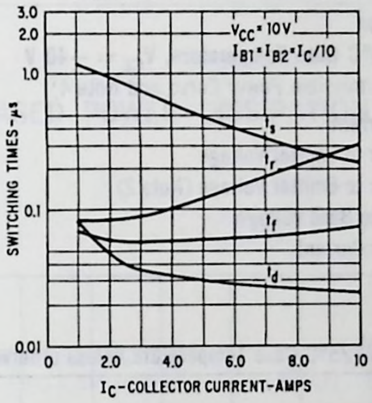
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT

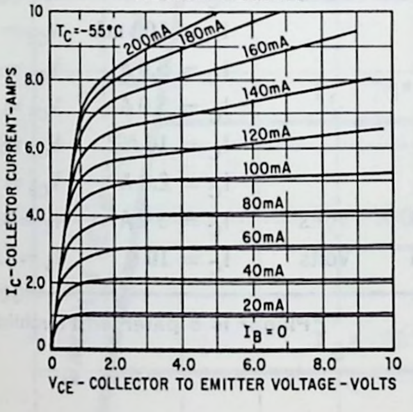


SWITCHING TIMES
VERSUS COLLECTOR CURRENT

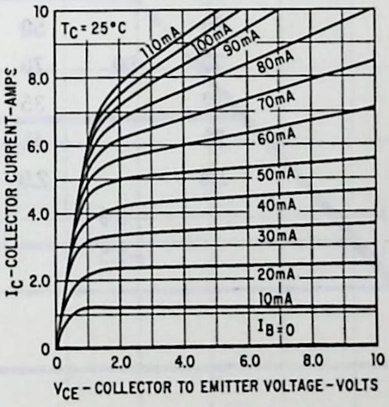


2N5008

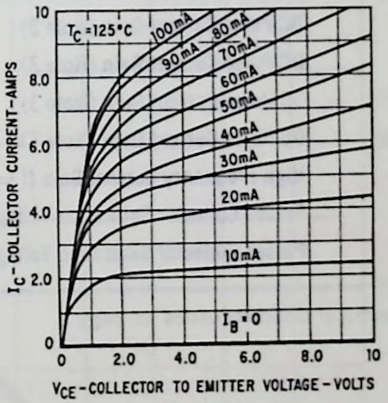
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



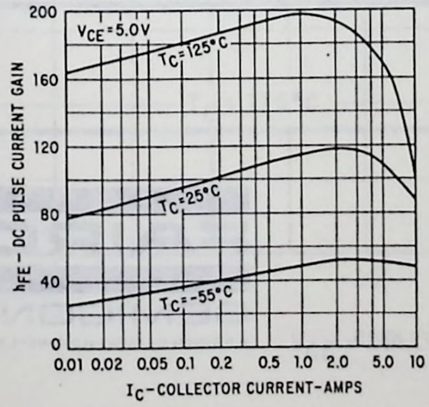
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



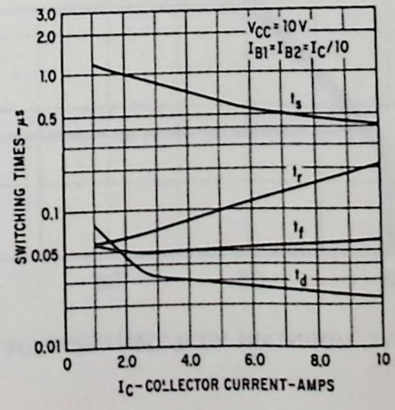
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



SWITCHING TIMES
VERSUS COLLECTOR CURRENT



°Single family characteristic on Transistor Curve Tracer.

2N5007 • 2N5009

100 WATT PNP POWER TRANSISTORS

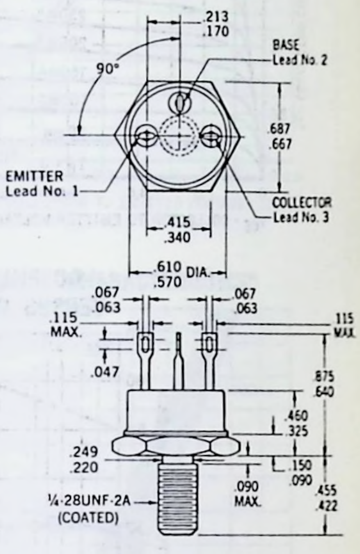
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5006 • 2N5008 FOR NPN COMPLEMENT

- **HIGH POWER . . . . 100 WATTS AT $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE . . . . −80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . −1.5 V (MAX) $V_{CE(sat)}$ AT 10 A**
- **HIGH FREQUENCY . . . . 30 AND 40 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 100 mA, 5.0 A AND 10 A**
- **ISOLATED COLLECTOR PACKAGE . . . . . . NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS

Similar to JEDEC (TO-61)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 14.1 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)		+300°C
Maximum Power Dissipation		
Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve and Note 4)		**100 Watts**
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	−80 Volts
V_{EBO}	Emitter to Base Voltage	−5.5 Volts
I_C	Collector Current	10 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5007 MIN.	2N5007 MAX.	2N5009 MIN.	2N5009 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**−80**		**−80**		**Volts**	$I_C = 200$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−100		−100		Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.5		−5.5		Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**		**50**			$I_C = 100$ mA	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**90**	**70**	**200**		$I_C = 5.0$ A	$V_{CE} = -5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	12		35			$I_C = 5.0$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**		**45**			$I_C = 10$ A	$V_{CE} = -5.0$ V
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**1.5**		**2.0**			$I_C = 2.0$ A	$V_{CE} = -5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		−0.9		−0.9	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 3)		**−1.5**		**−1.5**	**Volts**	$I_C = 10$ A	$I_B = 1.0$ A

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS 2N5007 • 2N5009

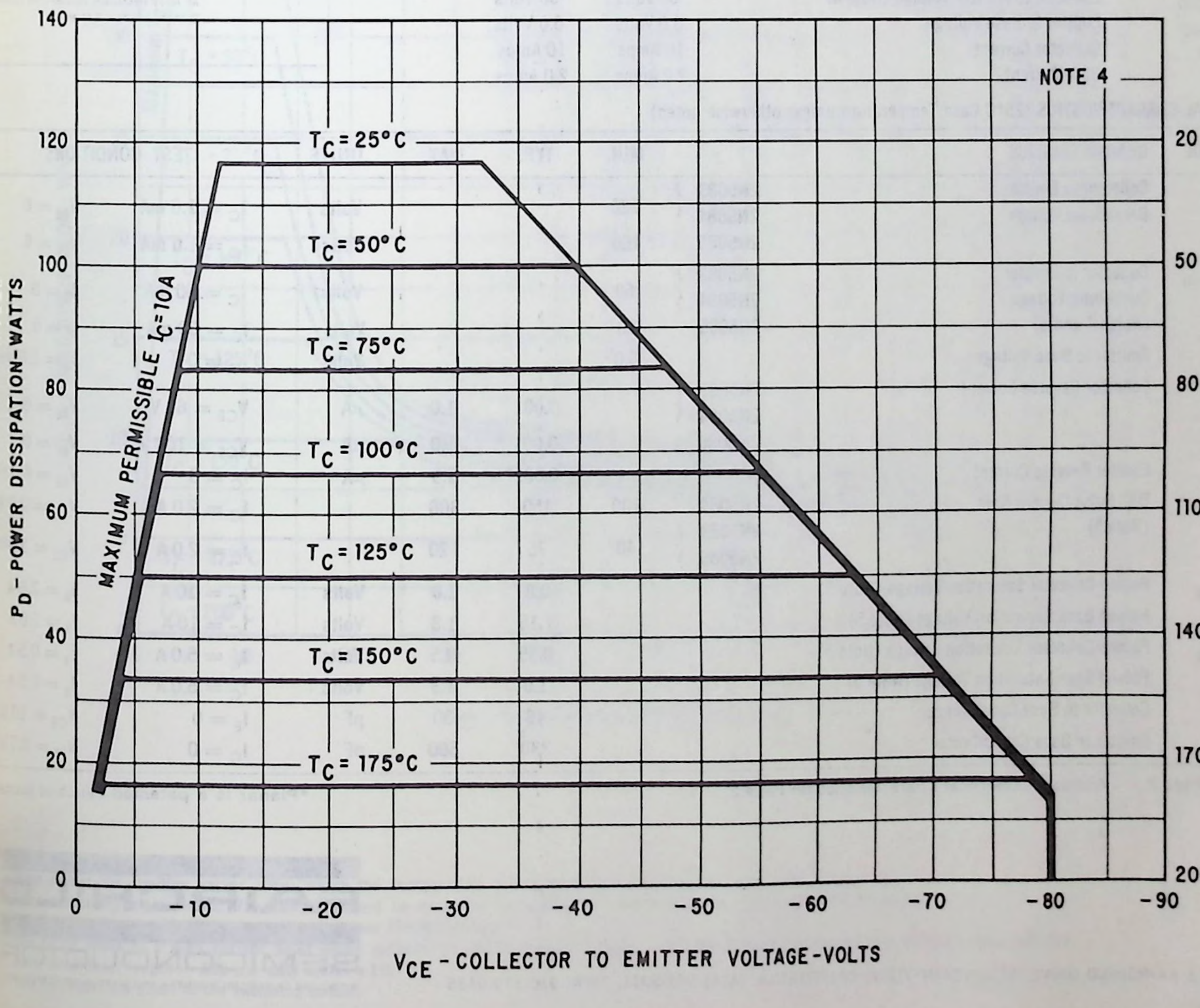
LECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5007 MIN.	2N5007 MAX.	2N5009 MIN.	2N5009 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−1.8		−1.8	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−2.2		−2.2	Volts	$I_C = 10$ A	$I_B = 1.0$ A
$V_{BE(on)}$	Pulsed Base Emitter "ON" Voltage (Note 3)		−1.8		−1.8	Volts	$I_C = 5.0$ A	$V_{CE} = -5.0$ V
I_{CES}	Collector Cutoff Current		1.0		1.0	μA	$V_{CE} = -60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		1.0		1.0	μA	$I_C = 0$	$V_{EB} = -4.0$ V
I_{CEX}(150°C)	Collector Reverse Current		500		500	μA	$V_{CE} = -60$ V	$V_{EB} = -2.0$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		500		500	pF	$I_E = 0$	$V_{CB} = -10$ V

TES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
This rating refers to a high current point where collector to emitter voltage is lowest.
Pulse Conditions: length = 300 μs; duty cycle = 1%.
Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

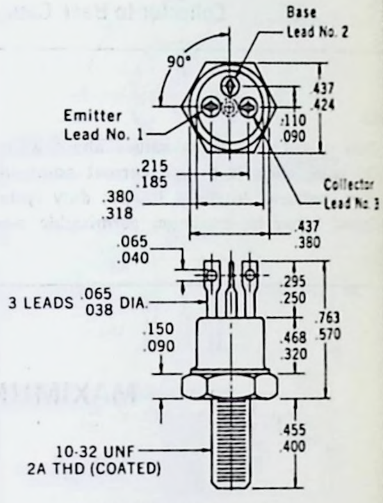


2N5083 • 2N5084 • 2N5085

35 WATT NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE . . . . . 150 AND 120 VOLT (MIN) BV_{CES}, 80 AND 60 VOLT (MIN) LV_{CEO}**
- **LOW $V_{CE(sat)}$ . . . . . . 1.0 VOLT (MAX) AT $I_C = 10$ A, $I_B = 2.0$ A**
- **HIGH SPEED . . . . . . MAX. t_{on} OF 350 ns AND t_{off} OF 650 ns AT $I_C = 5.0$ A, $I_B = 0.5$ A**
- **HIGH FREQUENCY . . . $f_T = 50$ AND 80 MHz (MIN)**
- **LOW LEAKAGE . . . . . MAX. I_{CES} OF 100 μA AT 150°C AS A RESULT OF PLANAR CONSTRUCTION**



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature Range	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	35 Watts

Maximum Voltages and Currents		2N5083 2N5084	2N5085
V_{CBO}	Collector to Base Voltage	120 Volts	150 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts	80 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	Collector Current	10 Amps	10 Amps
I_B	Base Current	2.0 Amps	2.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CES}	**Collector to Emitter Breakdown Voltage**	**2N5083 2N5084**	**120**			**Volts**	**$I_C = 1.0$ mA**	**$V_{BE} = 0$**
		2N5085	**150**			**Volts**	**$I_C = 1.0$ mA**	**$V_{BE} = 0$**
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	2N5083 2N5084	60			Volts	$I_C = 50$ mA	$I_B = 0$
		2N5085	80			Volts	$I_C = 50$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Voltage		6.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
I_{CES}	Collector Reverse Current	2N5083 2N5084		0.001	1.0	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
		2N5085		0.001	1.0	μA	$V_{CE} = 100$ V	$V_{BE} = 0$
I_{EBO}	Emitter Reverse Current			0.002	1.0	μA	$I_C = 0$	$V_{EB} = 4.0$ V
h_{FE}	D.C. Pulse Current Gain (Note 5)	2N5084	100	150	300		$I_C = 2.0$ A	$V_{CE} = 2.0$ V
		2N5083 2N5085	40	75	120		$I_C = 2.0$ A	$V_{CE} = 2.0$ V
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 5)**			**0.8**	**1.0**	**Volts**	**$I_C = 10$ A**	**$I_B = 2.0$ A**
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)			1.15	1.8	Volts	$I_C = 10$ A	$I_B = 2.0$ A
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)			0.35	0.5	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)			1.0	1.3	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
C_{cb}	Collector to Base Capacitance			45	80	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter to Base Capacitance			330	500	pF	$I_C = 0$	$V_{EB} = 0.5$ V

Notes on Page 2 Additional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process

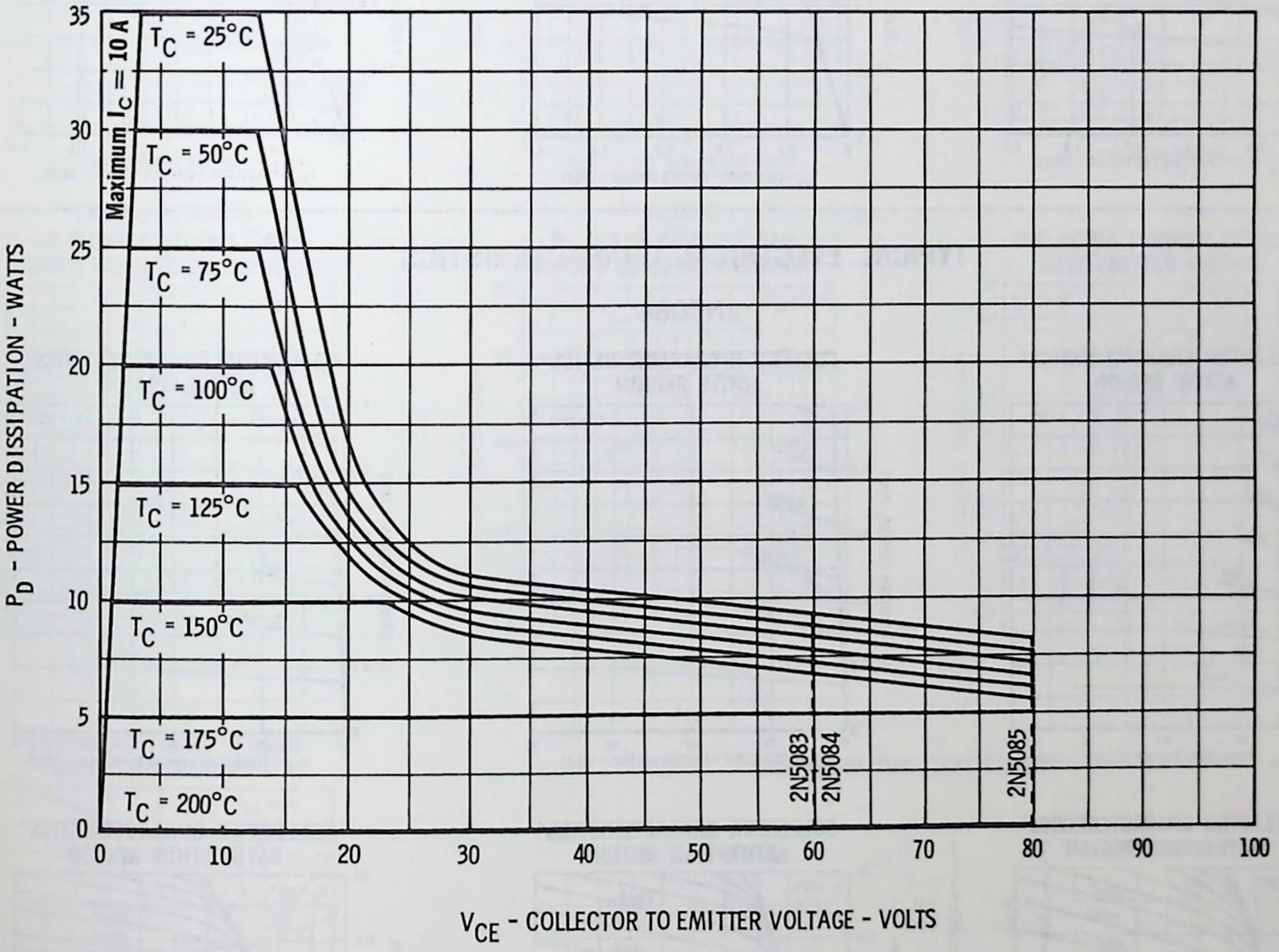
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS		MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
t_d	Delay Time (Note 6)			20	50	ns	$I_C = 5.0$ A	$I_{B1} = 0.5$ A
t_r	Rise Time (Note 6)			160	300	ns	$I_C = 5.0$ A	$I_{B1} = 0.5$ A
t_s	Storage Time (Note 6)			180	350	ns	$I_C = 5.0$ A	$I_{B1} = 0.5$ A $I_{B2} = -0.5$ A
t_f	Fall Time (Note 6)			120	300	ns	$I_C = 5.0$ A	$I_{B1} = 0.5$ A $I_{B2} = -0.5$ A
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2N5084	4.0	6.0			$I_C = 0.5$ A	$V_{CE} = 5.0$ V
		2N5083 2N5085	2.5	6.0			$I_C = 0.5$ A	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	D.C. Pulse Current Gain (Note 5)	2N5084	35	75			$I_C = 2.0$ A	$V_{CE} = 2.0$ V
		2N5083 2N5085	15	40			$I_C = 2.0$ A	$V_{CE} = 2.0$ V
$I_{CES}(150°C)$	Collector Reverse Current	2N5083 2N5084		2.0	100	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
		2N5085		3.0	100	μA	$V_{CE} = 100$ V	$V_{BE} = 0$

MAXIMUM PERMISSIBLE DC FORWARD BIAS POWER DISSIPATION



OTES:

) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

) See Maximum Permissible D.C. Forward Bias Power Dissipation graph.

) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

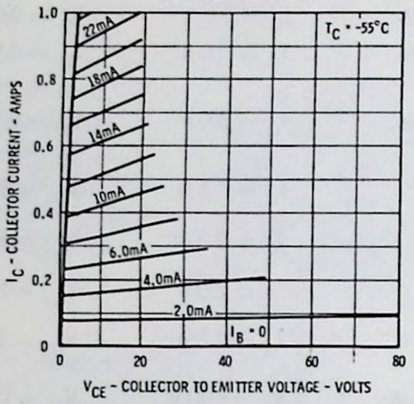
) Pulse Conditions: length = 300 μs; duty cycle = 1%.

) Test conditions are given in the switching circuit.

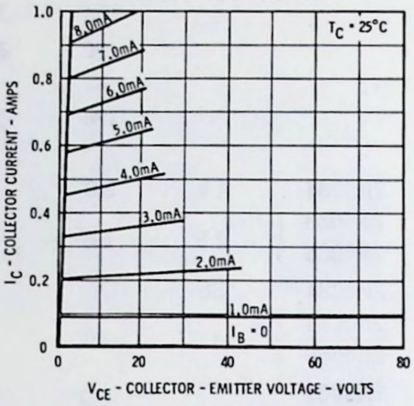
TYPICAL ELECTRICAL CHARACTERISTICS

2N5083 • 2N5085

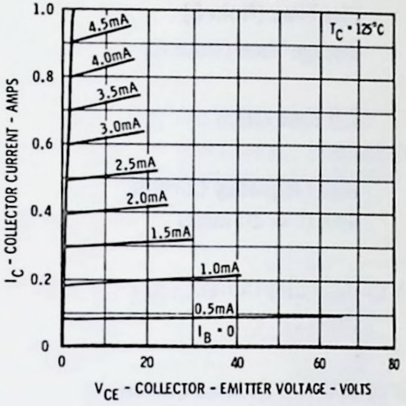
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



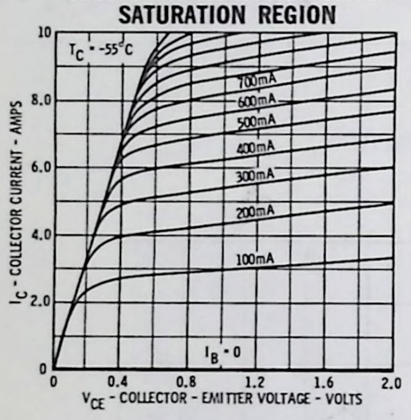
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



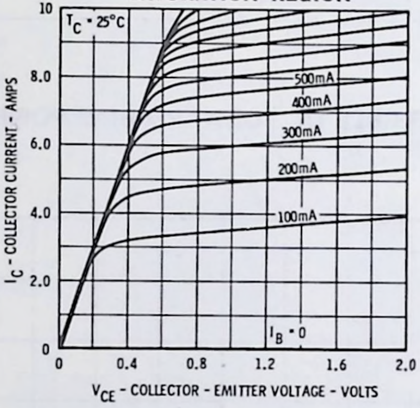
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



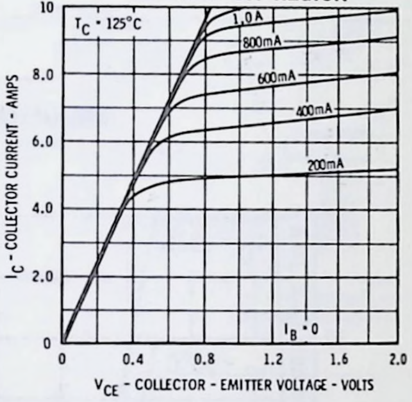
COLLECTOR CHARACTERISTICS*
SATURATION REGION



COLLECTOR CHARACTERISTICS*
SATURATION REGION



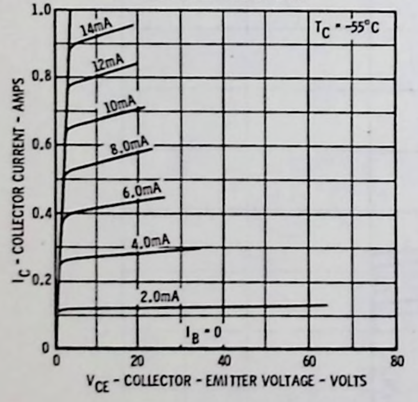
COLLECTOR CHARACTERISTICS*
SATURATION REGION



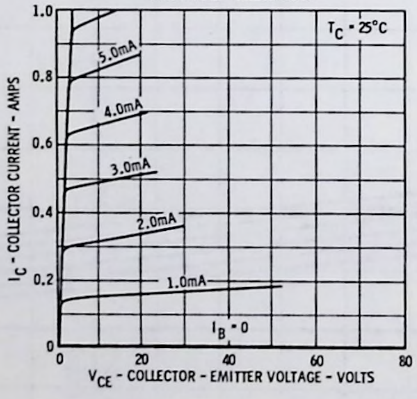
TYPICAL ELECTRICAL CHARACTERISTICS

2N5084

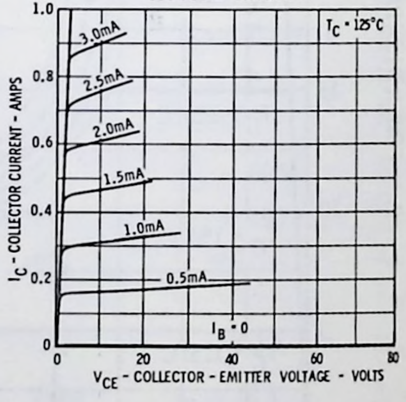
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



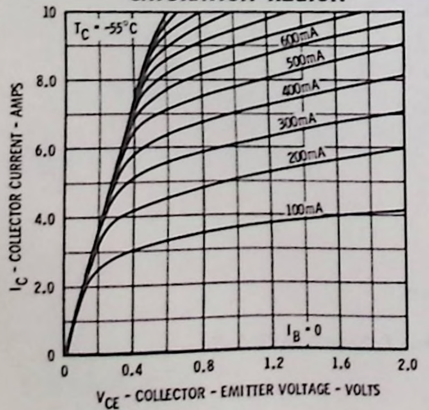
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



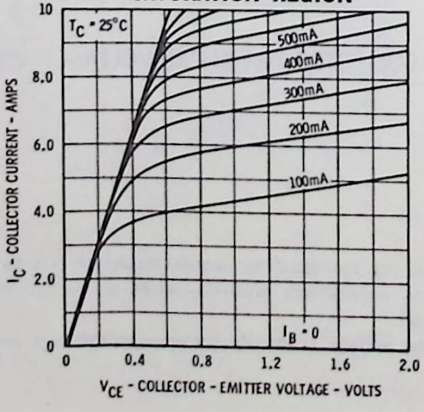
COLLECTOR CHARACTERISTICS*
ACTIVE REGION



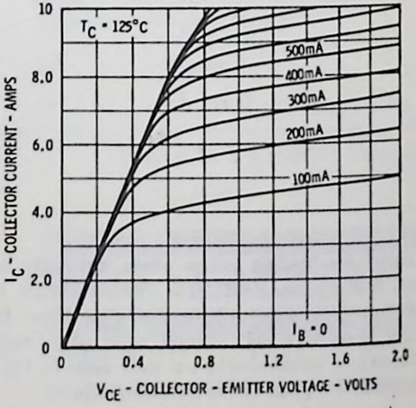
COLLECTOR CHARACTERISTICS*
SATURATION REGION



COLLECTOR CHARACTERISTICS*
SATURATION REGION



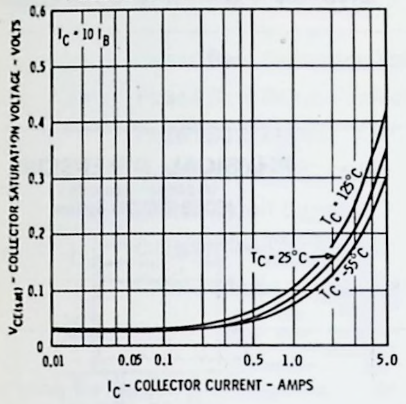
COLLECTOR CHARACTERISTICS*
SATURATION REGION



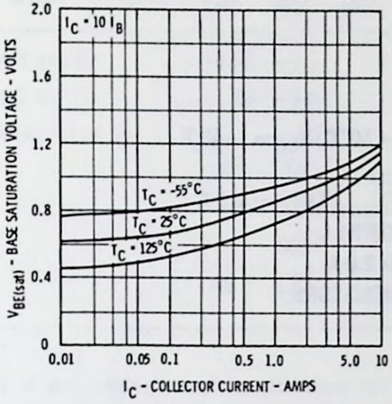
*Single family characteristics on Transistor Curve Tracer

TYPICAL ELECTRICAL CHARACTERISTICS

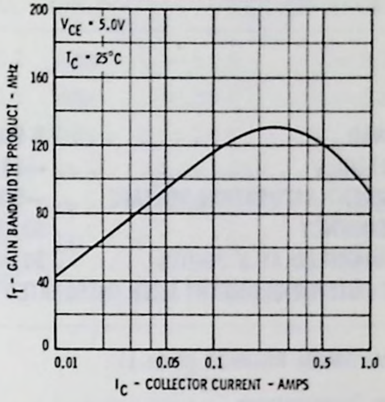
COLLECTOR SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



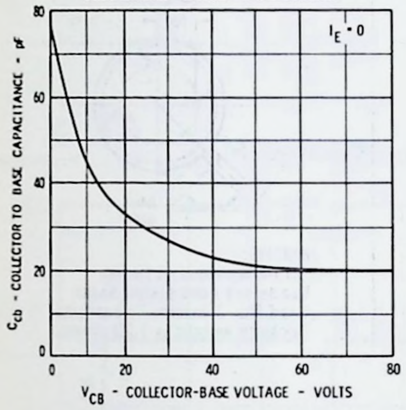
BASE SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



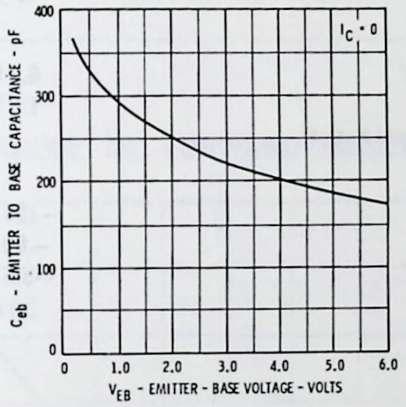
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



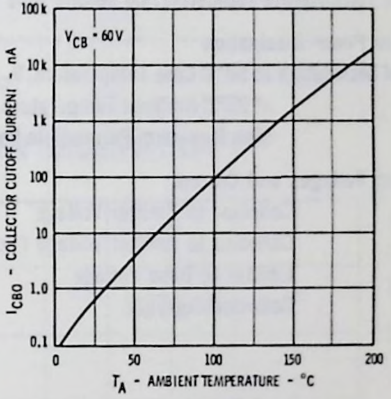
COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



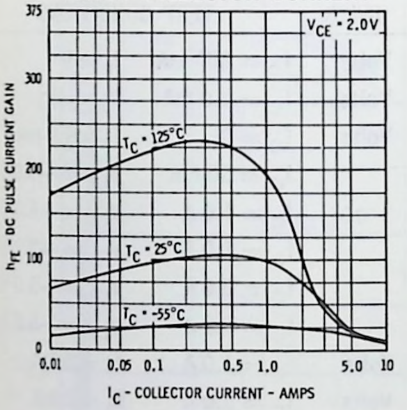
EMITTER TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



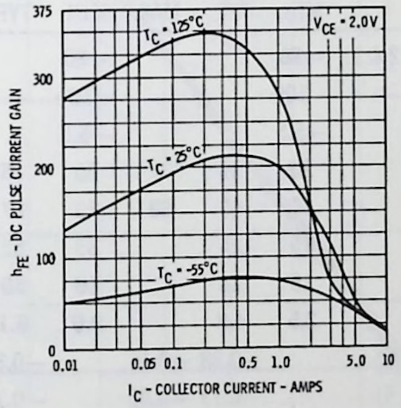
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



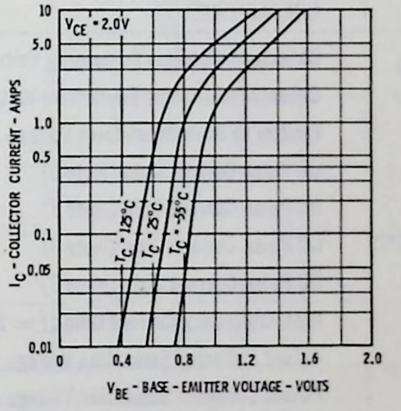
2N5083 • 2N5085
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



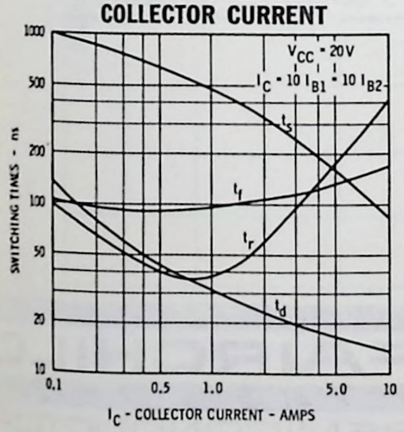
2N5084
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



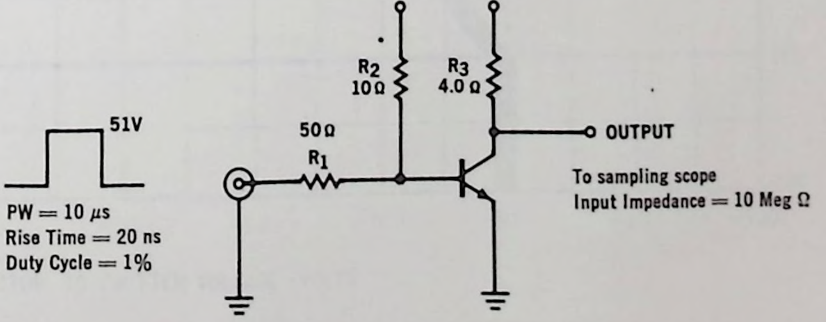
COLLECTOR CURRENT VERSUS BASE EMITTER VOLTAGE



SWITCHING TIMES VERSUS COLLECTOR CURRENT



SWITCHING TIME TEST CIRCUIT



PW = 10 μs
Rise Time = 20 ns
Duty Cycle = 1%

To sampling scope
Input Impedance = 10 Meg Ω

2N5147 • 2N5149

6 WATT PNP POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5148 • 2N5150 FOR NPN COMPLEMENT

- **HIGH POWER . . . . 6 WATTS AT $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE . . . . —80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . —0.85 V (MAX) $V_{CE(sat)}$ AT $I_C = 2.0$ A**
- **HIGH FREQUENCY . . . . 50 AND 60 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 50 mA, 1.0 A AND 2.0 A**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	—65°C to +200°C
Operating Junction Temperature	—65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

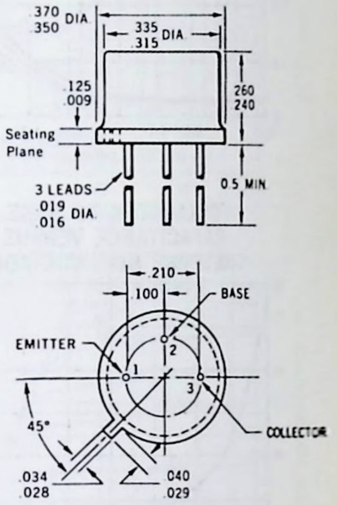
Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V	**6.0 Watts**
at 25°C Ambient Temperature	1.0 Watt
(See Maximum Permissible Power Curve and Note 4)	

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	—100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	—80 Volts
V_{EBO}	Emitter to Base Voltage	—5.5 Volts
I_C	Collector Current	2.0 Amps

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES:
All dimensions in inches.
Leads are gold plated Kovar.
Lead No. 3 internally connected to case.
Package weight is 1.23 grams.

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N5147			2N5149					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 & 3)	**—80**			**—80**			**Volts**	**$I_C = 100$ mA**	**$I_B = 0$**
BV_{CES}	Collector to Emitter Breakdown Voltage	—100			—100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	—5.5			—5.5			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**39**		**50**	**85**			**$I_C = 50$ mA**	**$V_{CE} = -5.0$ V**
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**40**	**90**	**70**	**87**	**200**		**$I_C = 1.0$ A**	**$V_{CE} = -5.0$ V**
h_{FE}(—55°C)	DC Pulse Current Gain (Note 3)	15	24		35	52			$I_C = 1.0$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**15**	**28**		**30**	**50**			**$I_C = 2.0$ A**	**$V_{CE} = -5.0$ V**
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**2.5**	**4.8**		**3.0**	**6.1**			**$I_C = 0.2$ A**	**$V_{CE} = -5.0$ V**
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Notes 3 & 5)		—0.38	—0.46		—0.38	—0.46	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Notes 3 & 5)		**—0.73**	**—0.85**		**—0.73**	**—0.85**	**Volts**	**$I_C = 2.0$ A**	**$I_B = 0.2$ A**

Additional Electrical Characteristics on page 2 Notes on page 2.

*Planar is a patented Fairchild proce

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

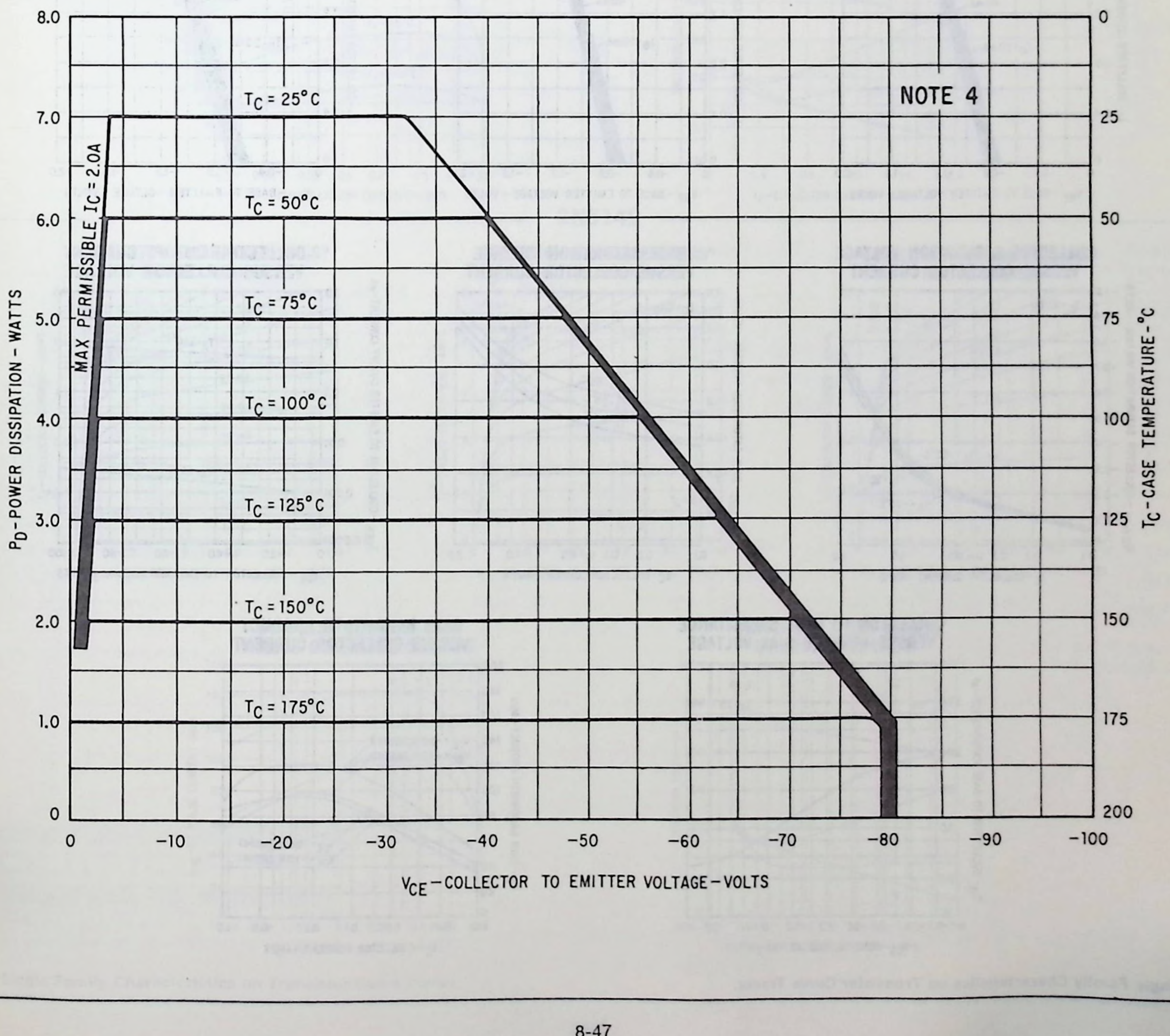
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N5147			2N5149					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		−0.96	−1.2		−0.96	−1.2	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		−1.28	−1.5		−1.28	−1.5	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
$V_{BE(on)}$	Pulsed Base Emitter "ON" Voltage (Notes 3 and 5)			−1.5			−1.5	Volts	$I_C = 2.0$ A	$V_{CE} = -5.0$ V
I_{CES}	Collector Cutoff Current		.002	1.0		.002	1.0	μA	$V_{CE} = -60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = -4.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = -60$ V	$V_{EB} = -2.0$ V
C_{cb}	Collector to Base Capacitance		46	120		46	120	pF	$I_E = 0$	$V_{CB} = -10$ V

NOTES:

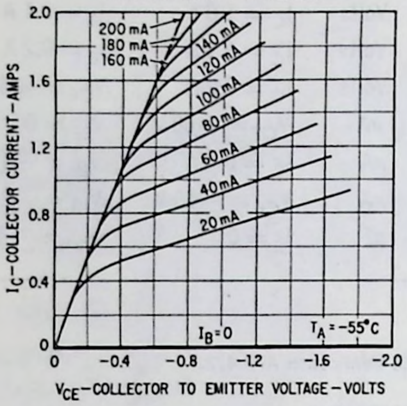
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(4) Device is thermally limited under free air (ambient) operating conditions. Maximum junction to ambient thermal resistant is 175°C/Watt.
(5) $V_{BE(on)}$ and saturation voltages measured ¼″ from header.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

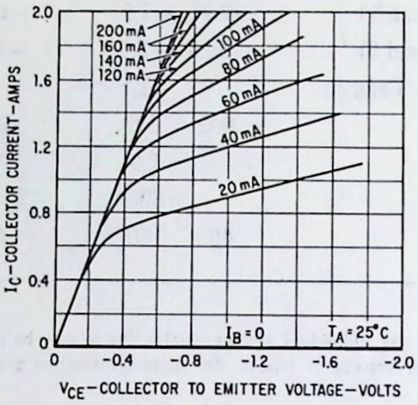


TYPICAL ELECTRICAL CHARACTERISTICS

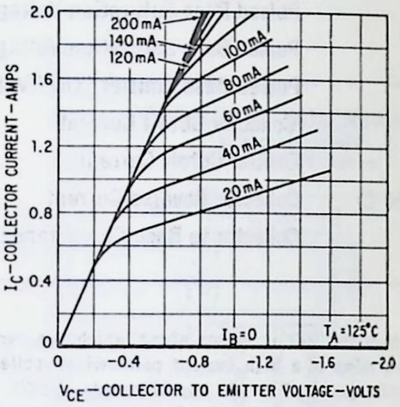
COLLECTOR CHARACTERISTICS* SATURATION REGION



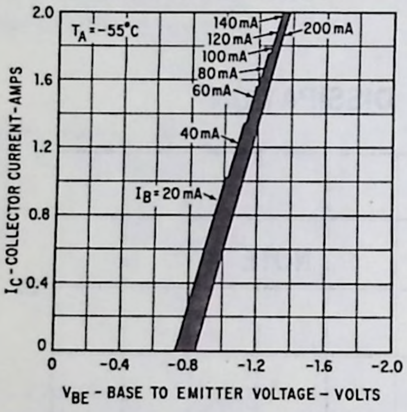
COLLECTOR CHARACTERISTICS* SATURATION REGION



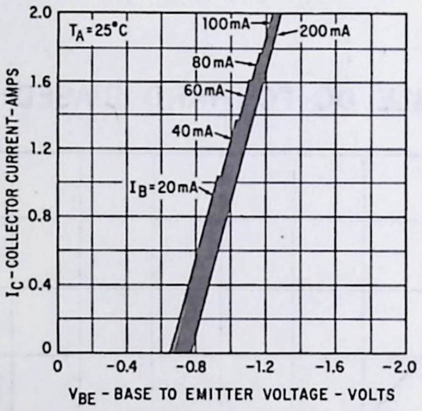
COLLECTOR CHARACTERISTICS* SATURATION REGION



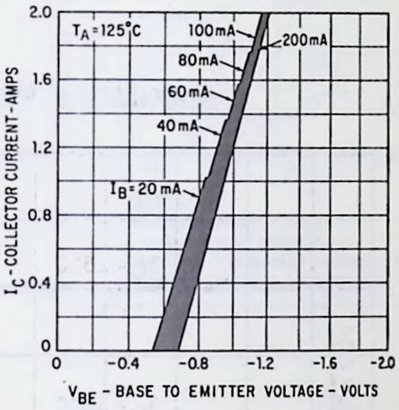
BASE CHARACTERISTICS*



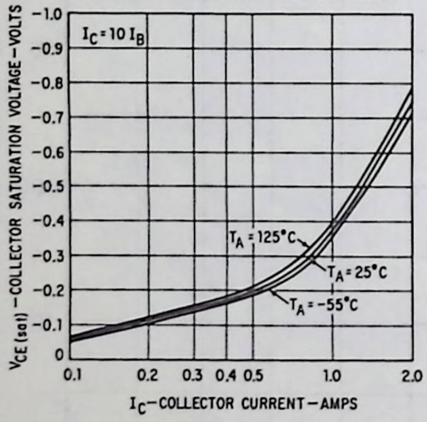
BASE CHARACTERISTICS*



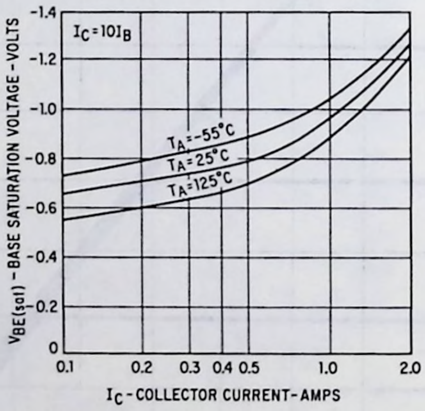
BASE CHARACTERISTICS*



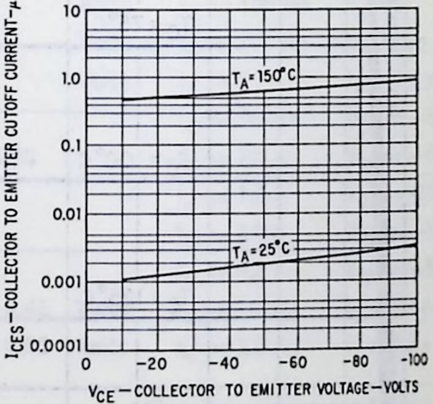
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



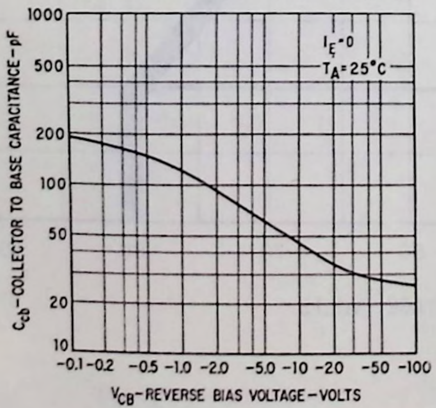
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



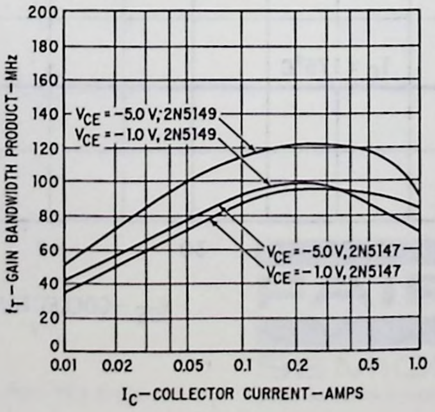
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

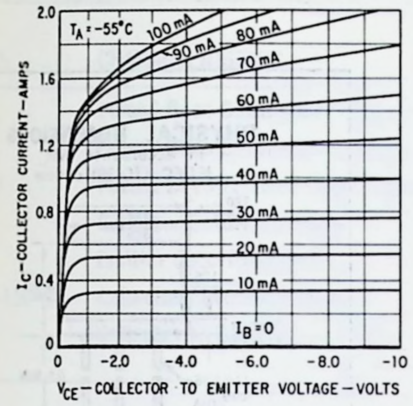


*Single Family Characteristics on Transistor Curve Tracer.

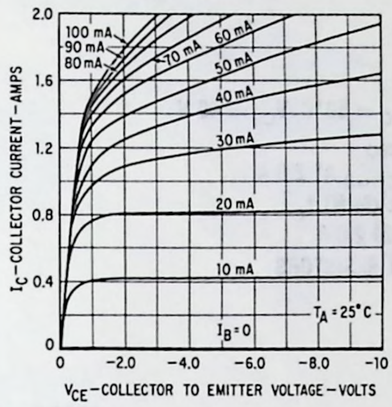
TYPICAL ELECTRICAL CHARACTERISTICS

2N5147

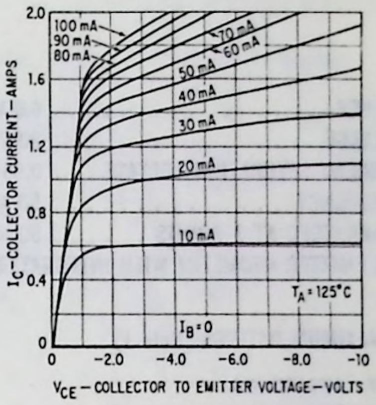
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



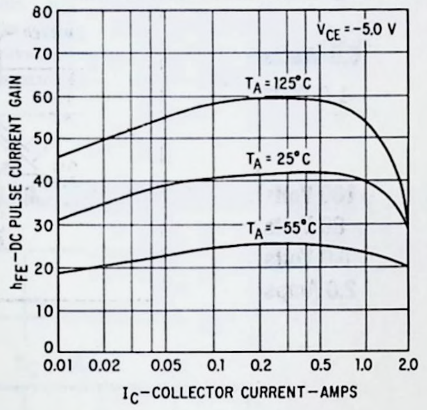
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



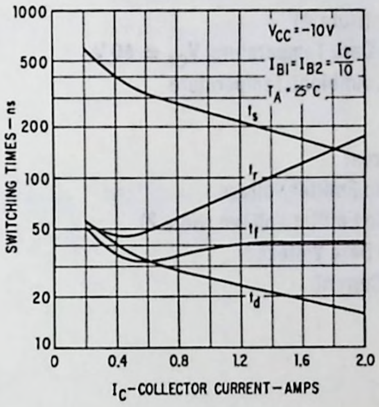
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT

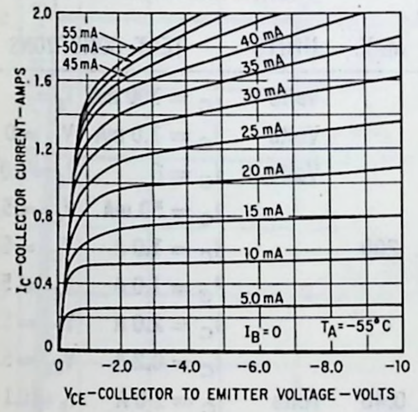


SWITCHING TIMES VERSUS
COLLECTOR CURRENT

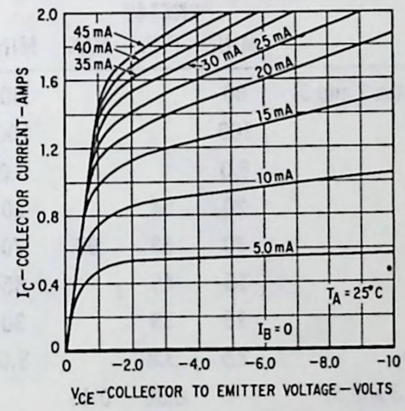


2N5149

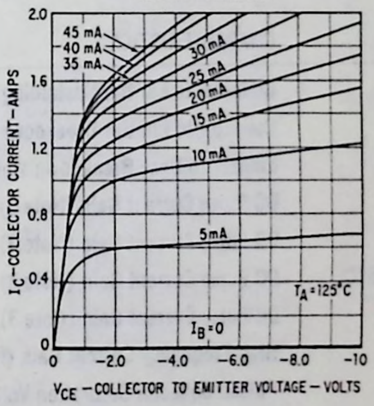
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



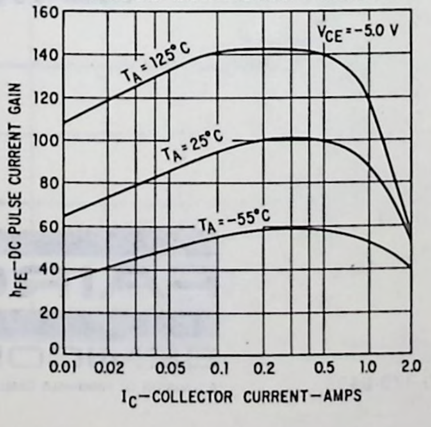
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



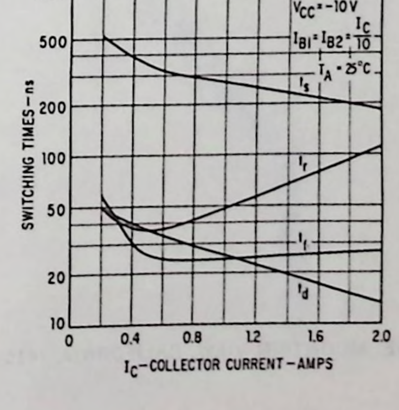
COLLECTOR CHARACTERISTICS°
ACTIVE REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS
COLLECTOR CURRENT



°Single Family Characteristics on Transistor Curve Tracer.

2N5148 • 2N5150

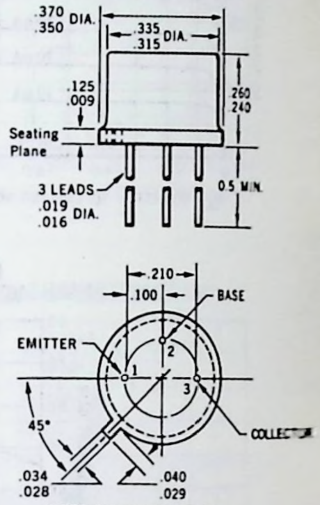
6 WATT NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5147 • 2N5149 FOR PNP COMPLEMENT

- **HIGH POWER . . . . 6.0 WATTS AT $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE . . . . 80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . 0.85 V (MAX) $V_{CE(sat)}$ AT 2.0 A**
- **HIGH FREQUENCY . . . . 50 AND 60 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 50 mA, 1.0 A AND 2.0 A**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C
Maximum Power Dissipation (Note 4)	
Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$ V	6.0 Watts
at 25°C Ambient Temperature	1.0 Watt
Maximum Voltages and Current	
V_{CES} Collector to Emitter Voltage	100 Volts
V_{CEO} Collector to Emitter Voltage (Note 2)	80 Volts
V_{EBO} Emitter to Base Voltage	6.0 Volts
I_C Collector Current	2.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5148 MIN.	2N5148 TYP.	2N5148 MAX.	2N5150 MIN.	2N5150 TYP.	2N5150 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	80			80			Volts	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	100			100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	20	64		50	120			$I_C = 50$ mA	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	30	63	90	70	110	200		$I_C = 1.0$ A	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	45		35	63			$I_C = 1.0$ A	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	15	33		30	56			$I_C = 2.0$ A	$V_{CE} = 5.0$ V
h_{fe}	**High Frequency Current Gain** (f = 20 MHz)	2.5	3.8		3.0	4.3			$I_C = 0.2$ A	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Notes 3 and 5)		0.38	0.46		0.38	0.46	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Notes 3 and 5)		0.75	0.85		0.75	0.85	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild process

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LECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5148 MIN.	2N5148 TYP.	2N5148 MAX.	2N5150 MIN.	2N5150 TYP.	2N5150 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		0.98	1.2		0.98	1.2	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		1.30	1.5		1.30	1.5	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
V_{BE}(on)	Pulsed Base Emitter "ON" Voltage (Notes 3 and 5)			1.5			1.5	Volts	$I_C = 2.0$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		.002	1.0		.002	1.0	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEX}(+150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = 60$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance		30	70		30	70	pF	$I_E = 0$	$V_{CB} = 10$ V

OTES:

These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

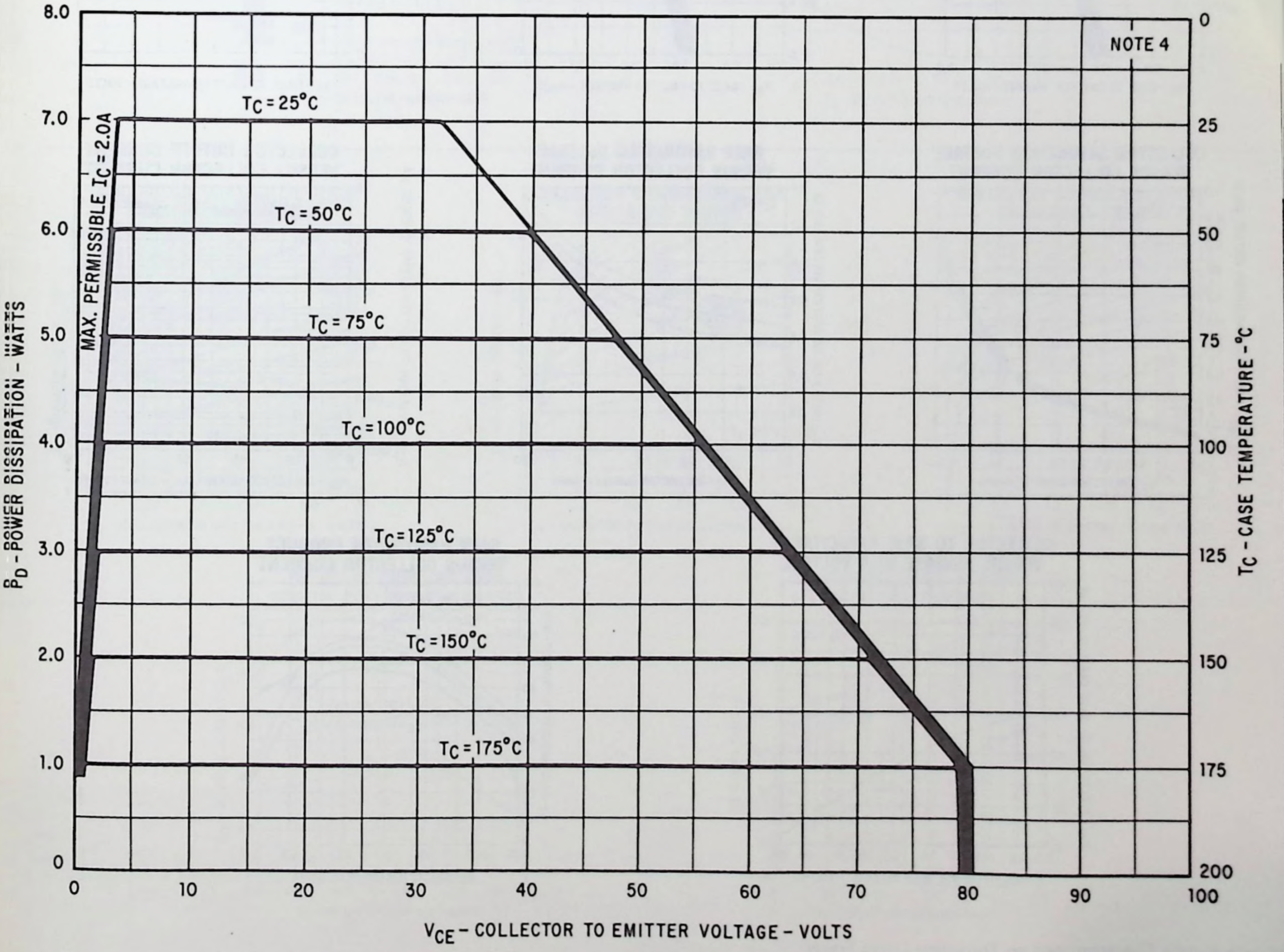
This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

Pulse Conditions: length = 300μs; duty cycle = 1%.

Device is thermally limited under free air (ambient) operating conditions. Maximum junction-to-ambient thermal resistance is 175°C/Watt. Contact factory for maximum permissible power under pulsed or reversed biased operating conditions.

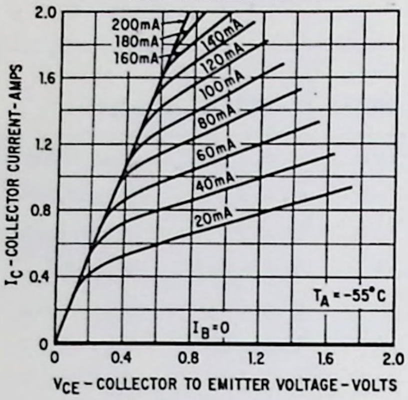
$V_{BE(on)}$ and saturation voltages measured ¼" from header.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

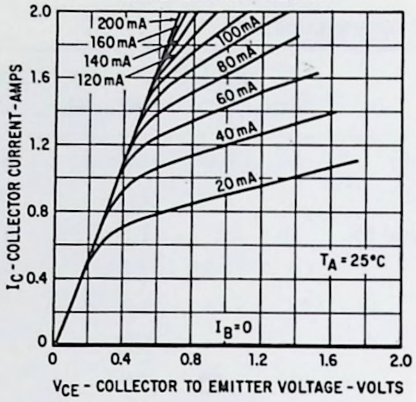


TYPICAL ELECTRICAL CHARACTERISTICS

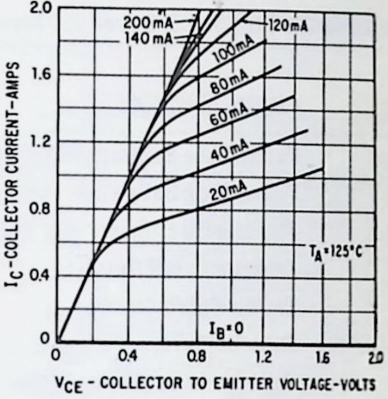
COLLECTOR CHARACTERISTICS*
SATURATION REGION



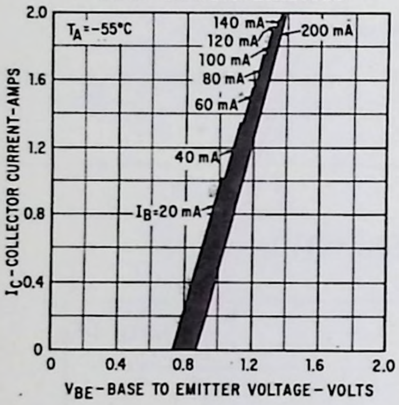
COLLECTOR CHARACTERISTICS*
SATURATION REGION



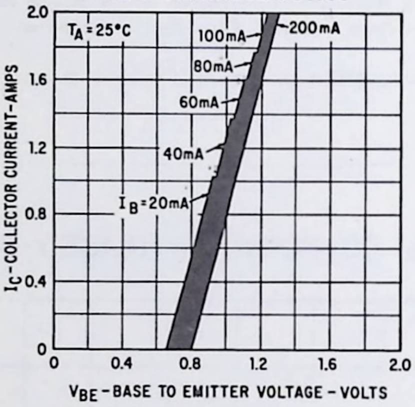
COLLECTOR CHARACTERISTICS*
SATURATION REGION



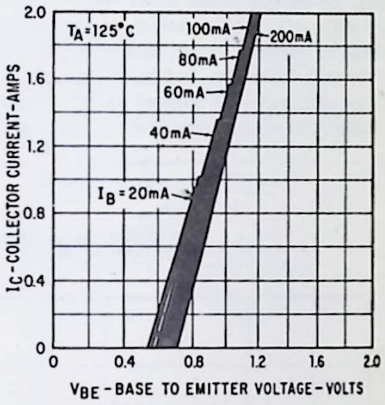
BASE CHARACTERISTICS*



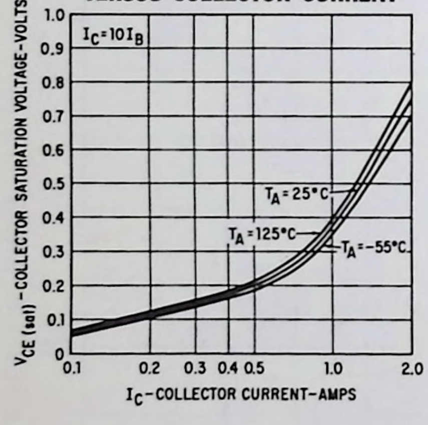
BASE CHARACTERISTICS*



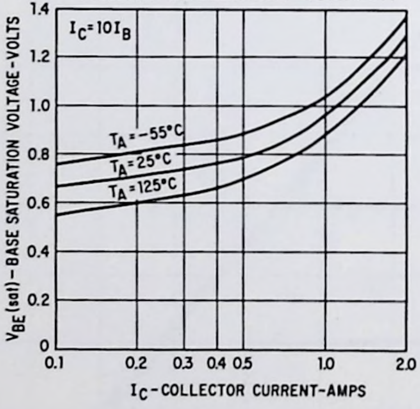
BASE CHARACTERISTICS*



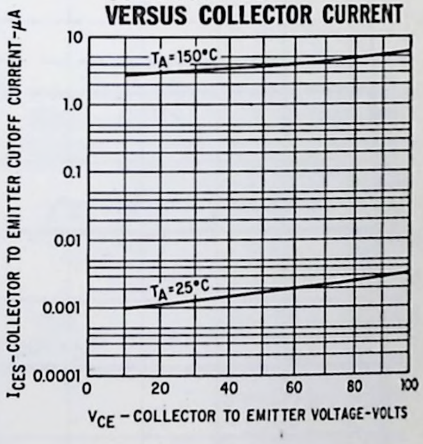
COLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



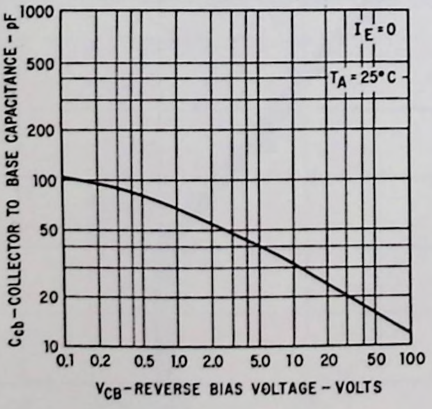
BASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENT



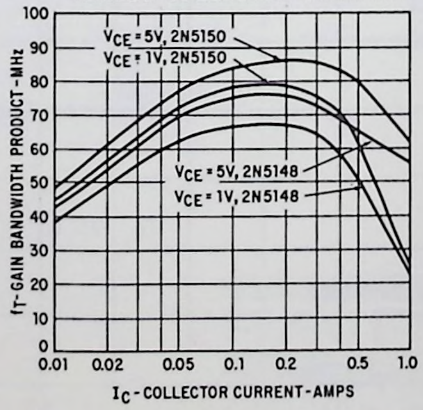
COLLECTOR CUTOFF CURRENT
VERSUS COLLECTOR CURRENT



COLLECTOR TO BASE CAPACITANCE
VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT
VERSUS COLLECTOR CURRENT

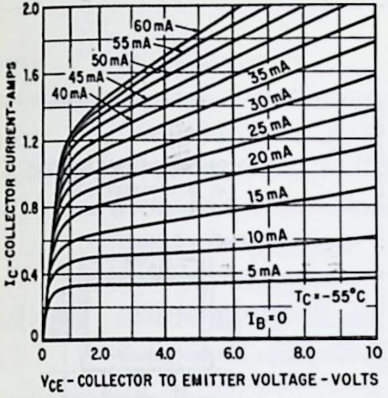


*Single Family Characteristics on Transistor Curve Tracer.

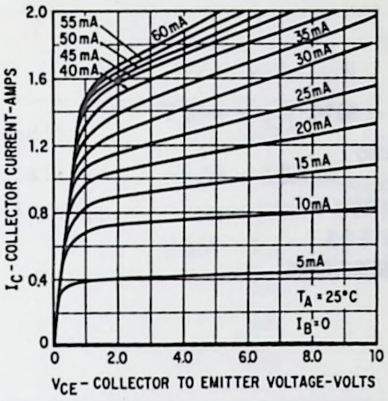
TYPICAL ELECTRICAL CHARACTERISTICS

2N5148

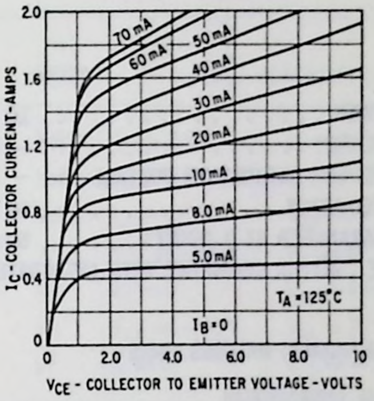
COLLECTOR CHARACTERISTICS*
SATURATION REGION



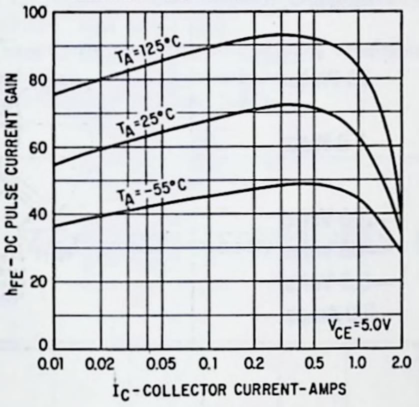
COLLECTOR CHARACTERISTICS*
SATURATION REGION



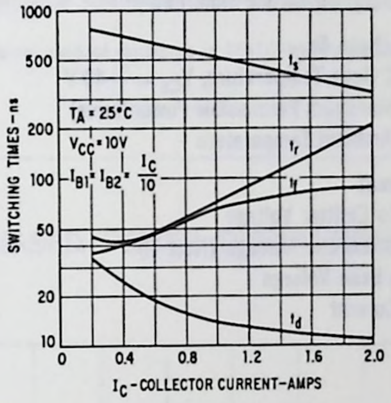
COLLECTOR CHARACTERISTICS*
SATURATION REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT

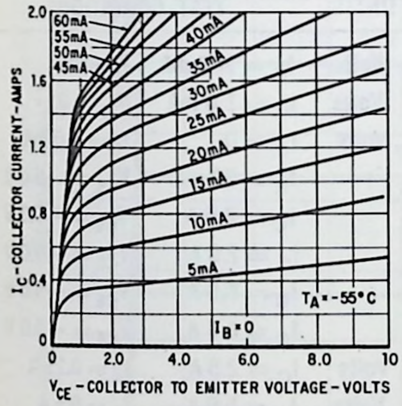


SWITCHING TIMES VERSUS
COLLECTOR CURRENT

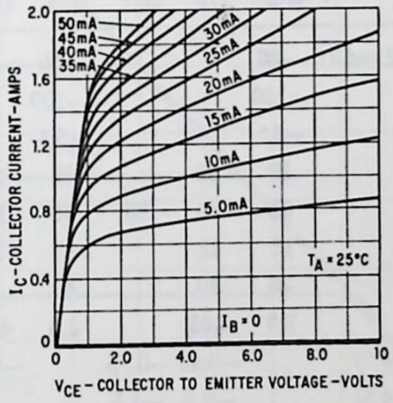


2N5150

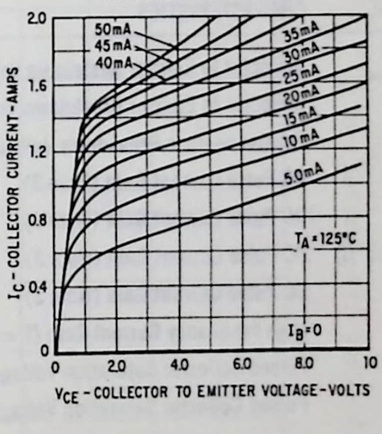
COLLECTOR CHARACTERISTICS*
SATURATION REGION



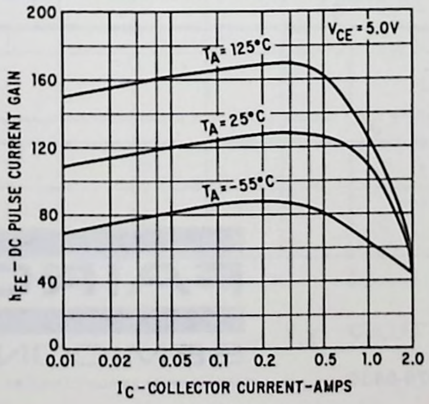
COLLECTOR CHARACTERISTICS*
SATURATION REGION



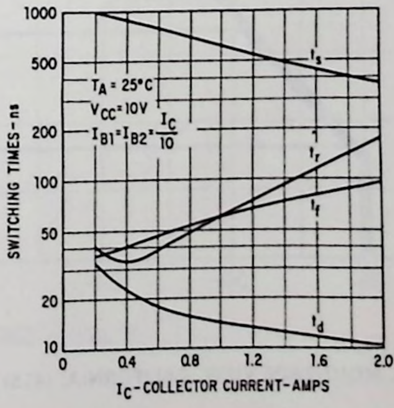
COLLECTOR CHARACTERISTICS*
SATURATION REGION



DC PULSE CURRENT GAIN
VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS
COLLECTOR CURRENT



*Single Family Characteristics on Transistor Curve Tracer.

2N5151 • 2N5153

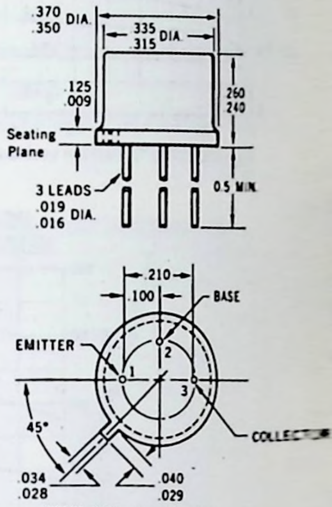
10 WATT PNP POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5152 • 2N5154 FOR NPN COMPLEMENT

- **HIGH POWER . . . . 10 WATTS AT $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE . . . . — 80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . — 1.5 V (MAX) $V_{CE(sat)}$ AT 5.0 A**
- **HIGH FREQUENCY . . . . 60 AND 70 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 50 mA, 2.5 A AND 5.0 A**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES All dimensions in inches
Leads are gold plated KOVAR
Lead No 3 internally connected to case
Package weight is 1 23 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)		+300°C
Maximum Power Dissipation (Note 4)		
Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve)		**10 Watts**
Total Dissipation at 25°C Ambient Temperature		1.0 Watt
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	−80 Volts
V_{EBO}	Emitter to Base Voltage	−5.5 Volts
I_C	Collector Current	5.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5151 MIN.	2N5151 TYP.	2N5151 MAX.	2N5153 MIN.	2N5153 TYP.	2N5153 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**−80**			**−80**			**Volts**	**$I_C = 100$ mA**	**$I_B = 0$**
BV_{CES}	Collector to Emitter Breakdown Volage	−100			−100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.5			−5.5			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**52**		**50**	**133**			**$I_C = 50$ mA**	**$V_{CE} = -5.0$ V**
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**50**	**90**	**70**	**114**	**200**		**$I_C = 2.5$ A**	**$V_{CE} = -5.0$ V**
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	32		35	90			$I_C = 2.5$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**38**		**40**	**77**			**$I_C = 5.0$ A**	**$V_{CE} = -5.0$ V**
h_{fe}	**High Frequency Current Gain** (f = 20 MHz)	**3.0**	**4.05**		**3.5**	**4.85**			**$I_C = 0.5$ A**	**$V_{CE} = -5.0$ V**
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Notes 3 and 5)		−0.45	−0.75		−0.45	−0.75	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Notes 3 and 5)		**−0.9**	**−1.5**		**−0.9**	**−1.5**	**Volts**	**$I_C = 5.0$ A**	**$I_B = 0.5$ A**

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild proce

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

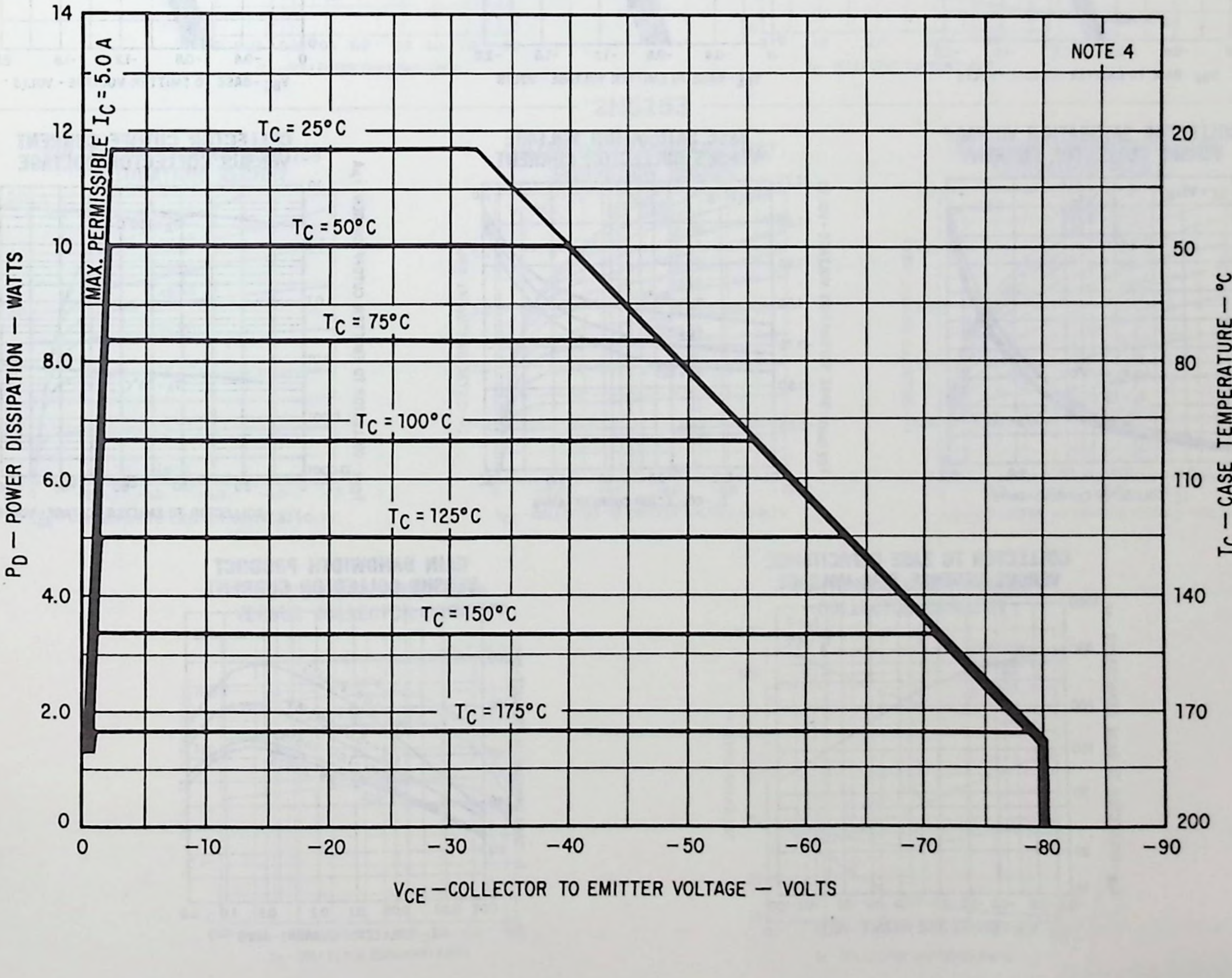
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5151 MIN.	2N5151 TYP.	2N5151 MAX.	2N5153 MIN.	2N5153 TYP.	2N5153 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		−1.1	−1.45		−1.1	−1.45	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		−1.55	−2.2		−1.55	−2.2	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(on)}$	Pulsed Base Emitter "On" Voltage (Notes 3 and 5)			−1.45			−1.45	Volts	$I_C = 2.5$ A	$V_{CE} = -5.0$ V
I_{CES}	Collector Cutoff Current		0.006	1.0		0.006	1.0	μA	$V_{CE} = -60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{BE} = 4.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = -60$ V	$V_{BE} = 2.0$ V
C_{cb}	Collector to Base Capacitance		170	250		170	250	pF	$I_E = 0$	$V_{CB} = -10$ V

NOTES:

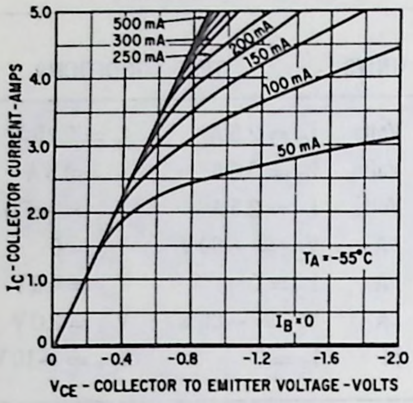
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(4) Device is thermally limited under free air (ambient) operating conditions. Maximum junction-to-ambient thermal resistance is 175°C/Watt. Contact factory for maximum permissible power under pulsed or reversed biased operating conditions.
(5) $V_{BE(on)}$ and saturation voltages measured ¼" from header.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

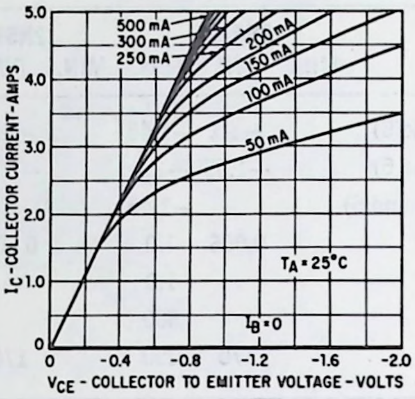


TYPICAL ELECTRICAL CHARACTERISTICS

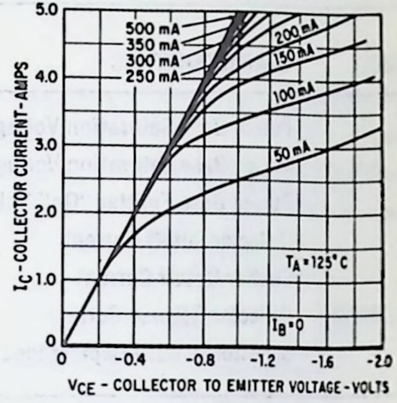
COLLECTOR CHARACTERISTICS* SATURATION REGION



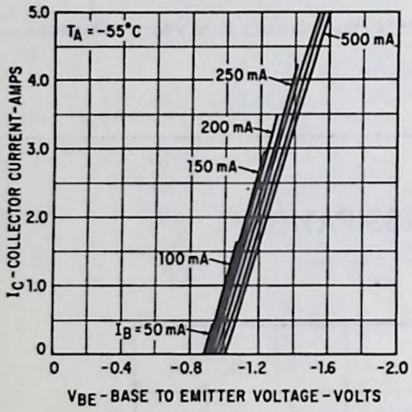
COLLECTOR CHARACTERISTICS* SATURATION REGION



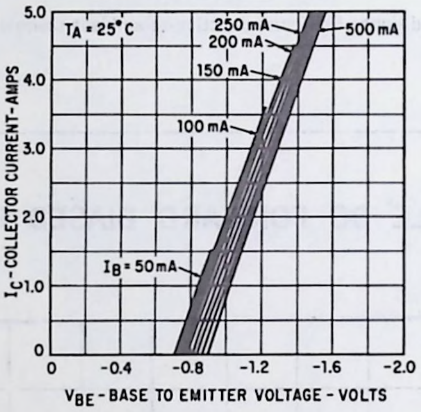
COLLECTOR CHARACTERISTICS* SATURATION REGION



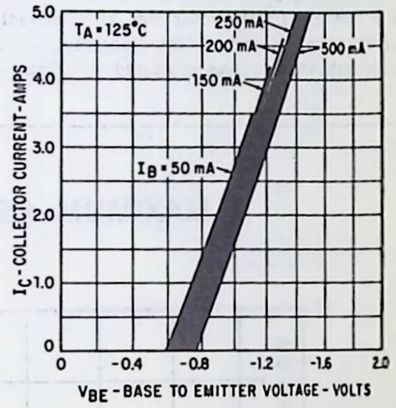
BASE CHARACTERISTICS*



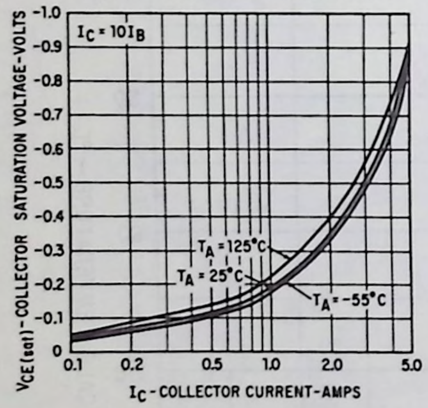
BASE CHARACTERISTICS*



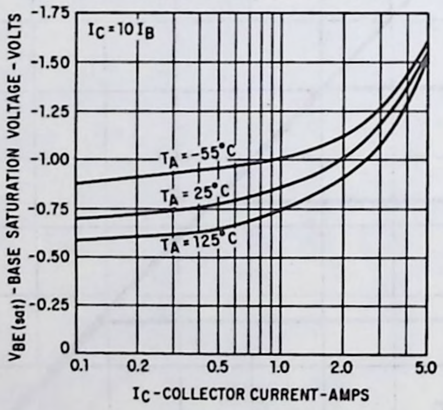
BASE CHARACTERISTICS*



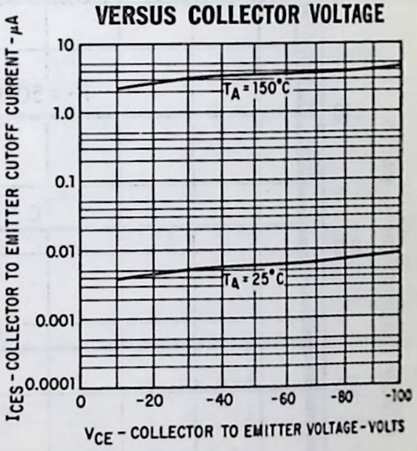
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



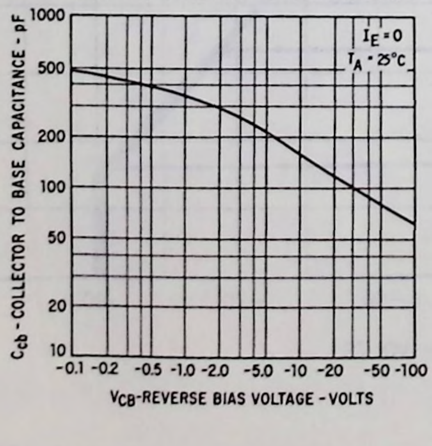
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



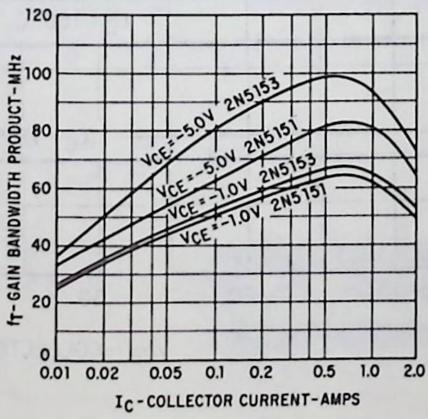
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

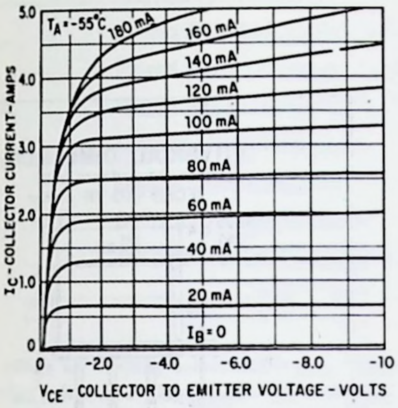


*Single Family Characteristics on Transistor Curve Tracer.

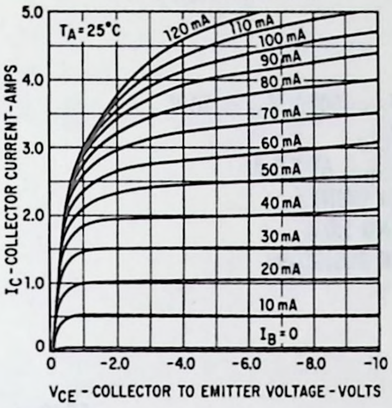
TYPICAL ELECTRICAL CHARACTERISTICS

2N5151

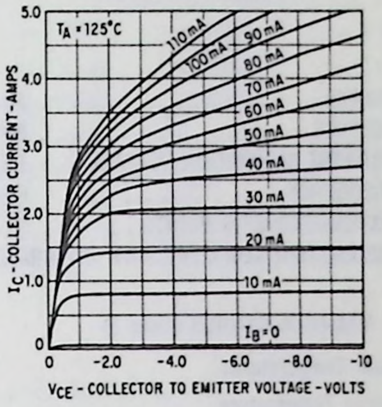
COLLECTOR CHARACTERISTICS* SATURATION REGION



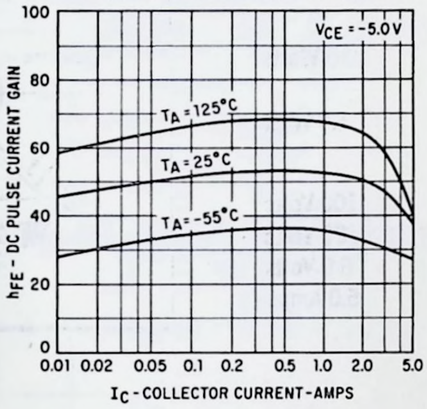
COLLECTOR CHARACTERISTICS* SATURATION REGION



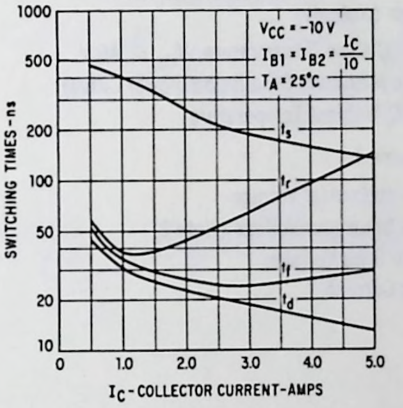
COLLECTOR CHARACTERISTICS* SATURATION REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

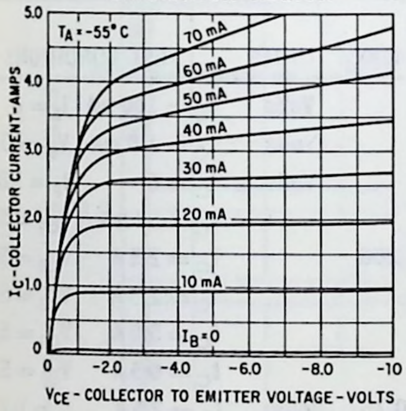


SWITCHING TIMES VERSUS COLLECTOR CURRENT

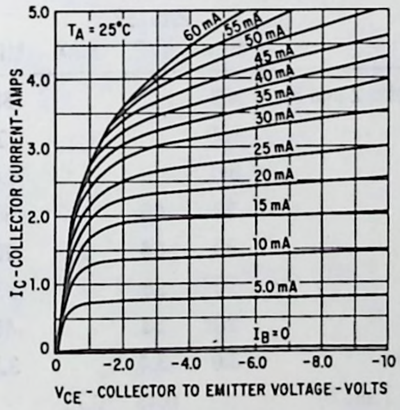


2N5153

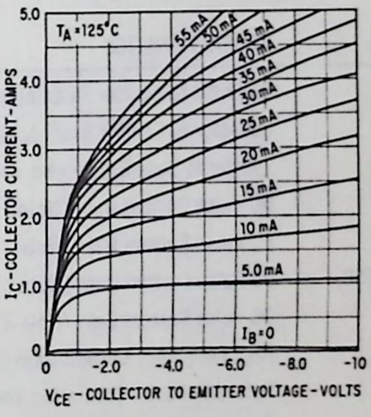
COLLECTOR CHARACTERISTICS* SATURATION REGION



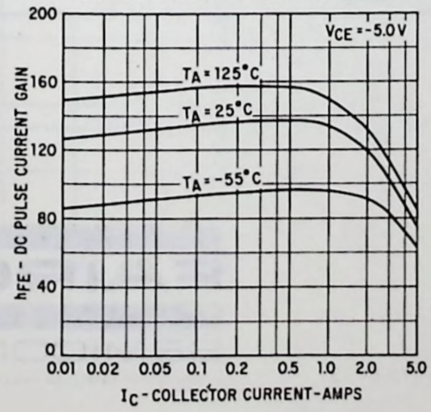
COLLECTOR CHARACTERISTICS* SATURATION REGION



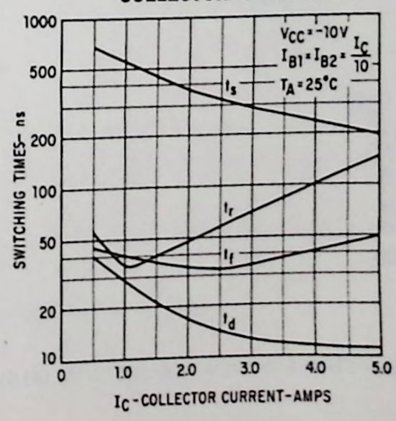
COLLECTOR CHARACTERISTICS* SATURATION REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT



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*Single Family Characteristics on Transistor Curve Tracer.

2N5152 • 2N5154

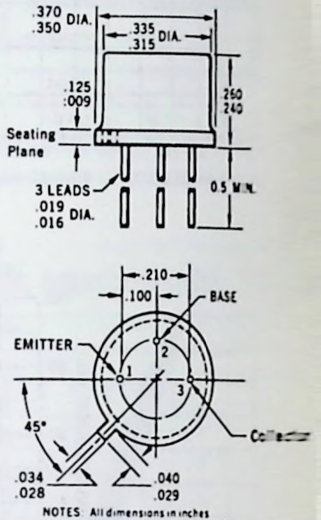
10 WATT NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5151 • 2N5153 FOR PNP COMPLEMEN

- **HIGH POWER . . . . 10 WATTS AT $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE . . . . 80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . 1.5 V (MAX) $V_{CE(sat)}$ AT 5.0 A**
- **HIGH FREQUENCY . . . . 60 AND 70 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 50 mA, 2.5 A AND 5.0 A**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES: All dimensions in inches
Leads are gold plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation (Note 4)

Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$ V (See Maximum Permissible Power Curve)	**10 Watts**
Total Dissipation at 25°C Ambient Temperature	1.0 Watt

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	80 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	5.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5152 MIN.	TYP.	MAX.	2N5154 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage (Notes 2 and 3)**	80			80			Volts	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	100			100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 1.0$ m
h_{FE}	**DC Pulse Current Gain (Note 3)**	20	46		50	100			$I_C = 50$ mA	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain (Note 3)**	30	64	90	70	114	200		$I_C = 2.5$ A	$V_{CE} = 5.0$ V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 3)	15	26		35	50			$I_C = 2.5$ A	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain (Note 3)**	20	53		40	65			$I_C = 5.0$ A	$V_{CE} = 5.0$ V
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	3.0	3.4		3.5	4.4			$I_C = 0.5$ A	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Notes 3 and 5)		0.43	0.75		0.43	0.75	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Notes 3 and 5)**		0.85	1.5		0.85	1.5	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild proc

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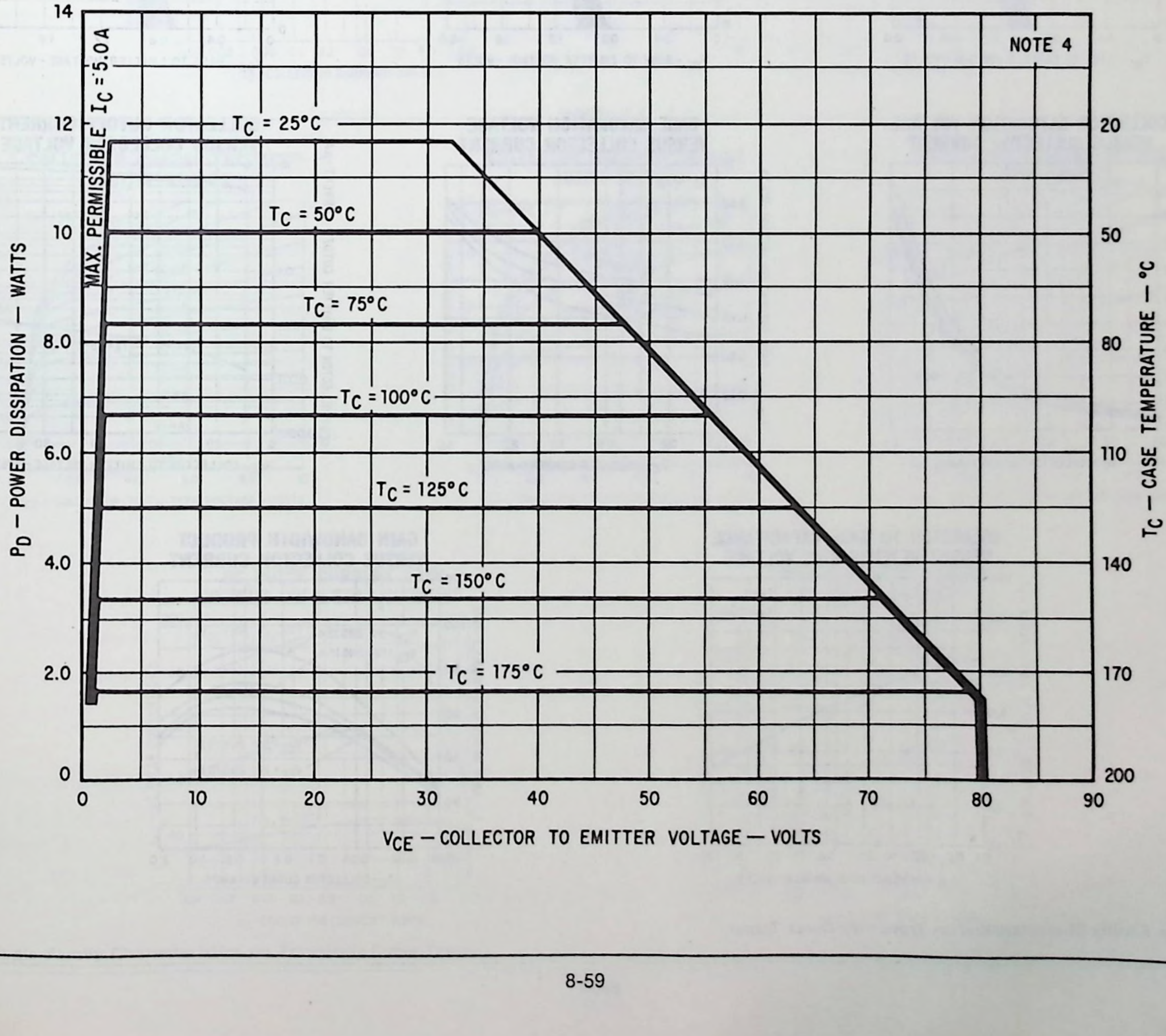
ELLECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N5152 MIN.	2N5152 TYP.	2N5152 MAX.	2N5154 MIN.	2N5154 TYP.	2N5154 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		1.16	1.45		1.16	1.45	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 3 and 5)		1.52	2.2		1.52	2.2	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE}(on)$	Pulsed Base Emitter "ON" Voltage (Notes 3 and 5)			1.45			1.45	Volts	$I_C = 2.5$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		0.007	1.0		0.007	1.0	µA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	µA	$I_C = 0$	$V_{EB} = 5.0$ V
$I_{CEX}(+150°C)$	Collector Reverse Current			500			500	µA	$V_{CE} = 60$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance		80	250		80	250	pF	$I_E = 0$	$V_{CB} = 10$ V

NOOTES:

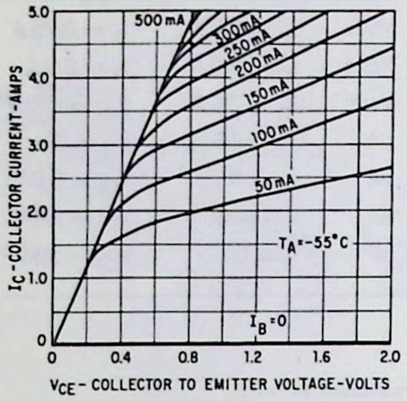
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300µs; duty cycle = 1%.
(4) Device is thermally limited under free air (ambient) operating conditions. Maximum junction-to-ambient thermal resistance is 175°C/Watt. Contact factory for maximum permissible power under pulsed or reversed biased operating conditions.
(5) $V_{BE(on)}$ and saturation voltages measured ¼" from header.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

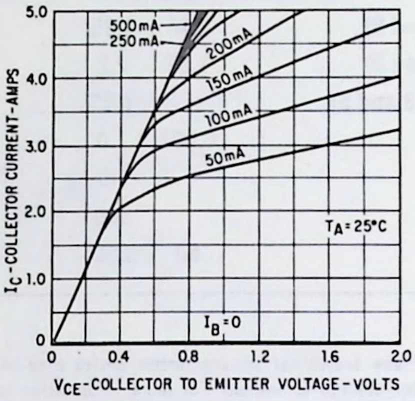


TYPICAL ELECTRICAL CHARACTERISTICS

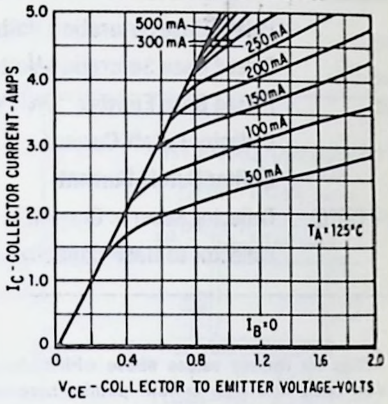
COLLECTOR CHARACTERISTICS* SATURATION REGION



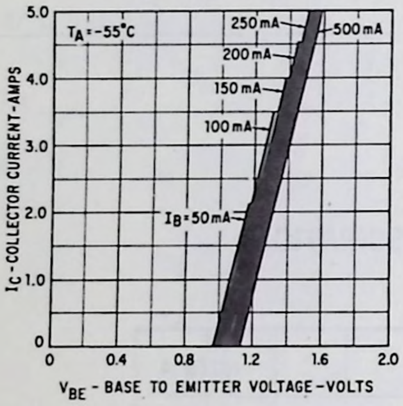
COLLECTOR CHARACTERISTICS* SATURATION REGION



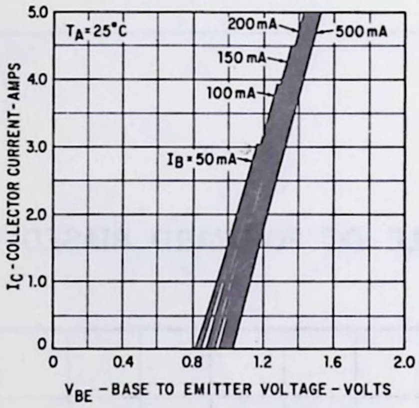
COLLECTOR CHARACTERISTICS* SATURATION REGION



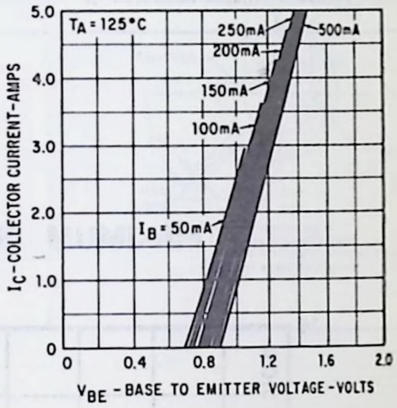
BASE CHARACTERISTICS*



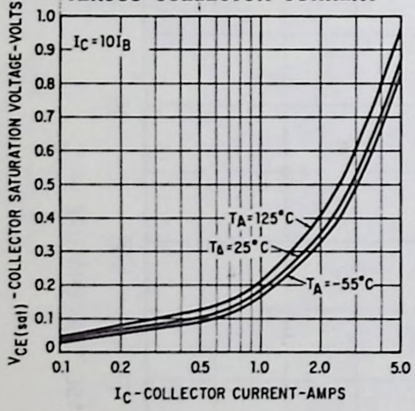
BASE CHARACTERISTICS*



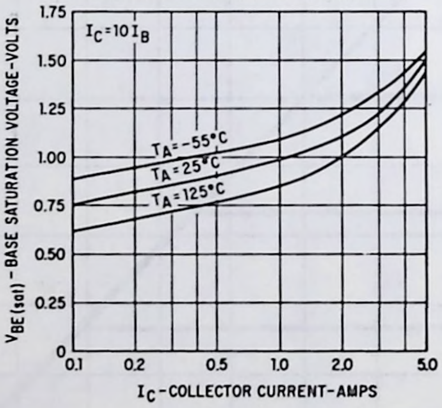
BASE CHARACTERISTICS*



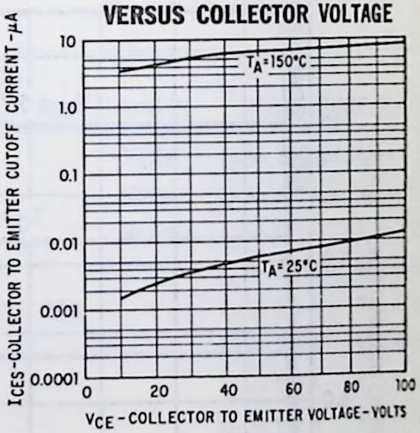
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



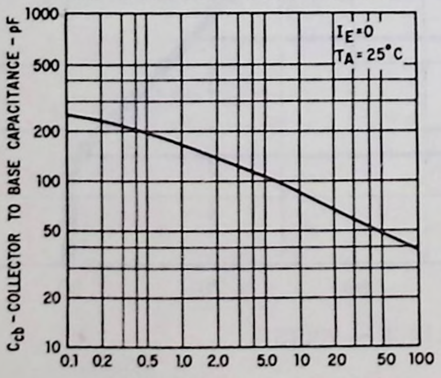
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



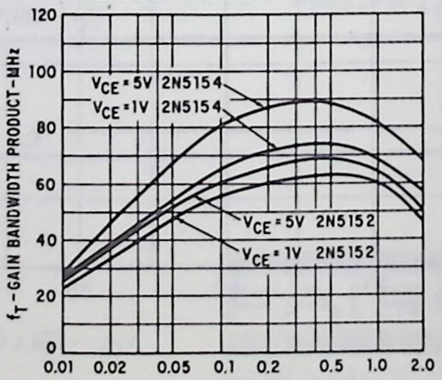
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

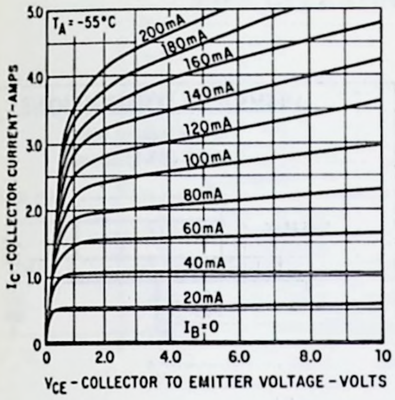


*Single Family Characteristics on Transistor Curve Tracer.

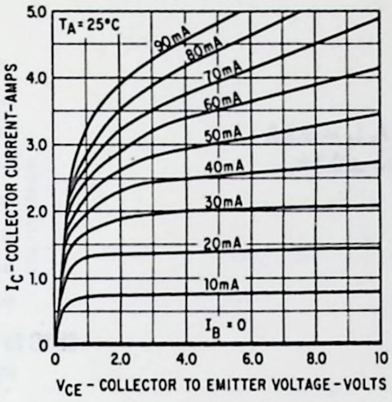
TYPICAL ELECTRICAL CHARACTERISTICS

2N5152

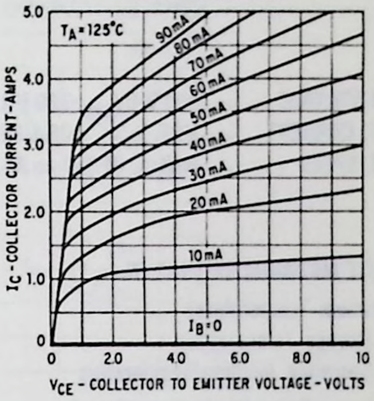
COLLECTOR CHARACTERISTICS* ACTIVE REGION



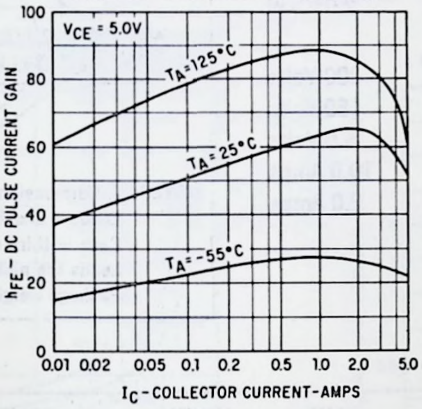
COLLECTOR CHARACTERISTICS* ACTIVE REGION



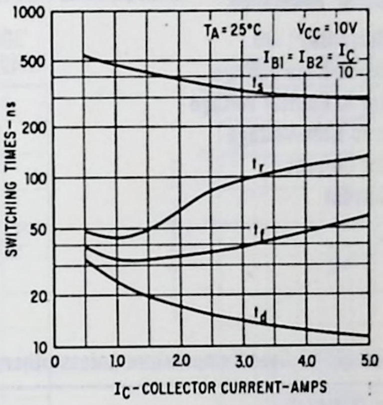
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

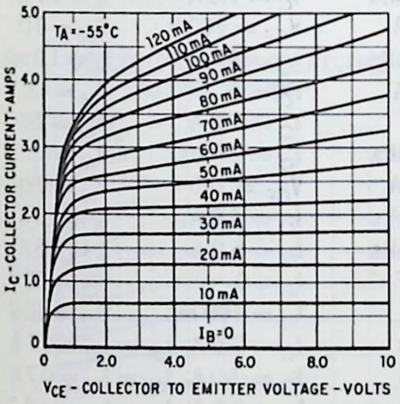


SWITCHING TIMES VERSUS COLLECTOR CURRENT

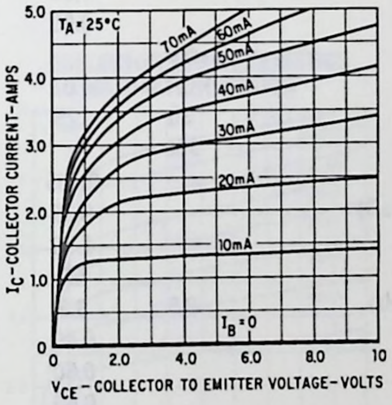


2N5154

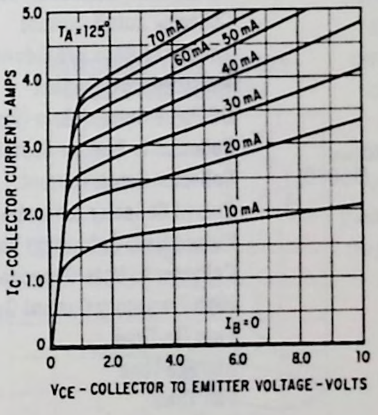
COLLECTOR CHARACTERISTICS* ACTIVE REGION



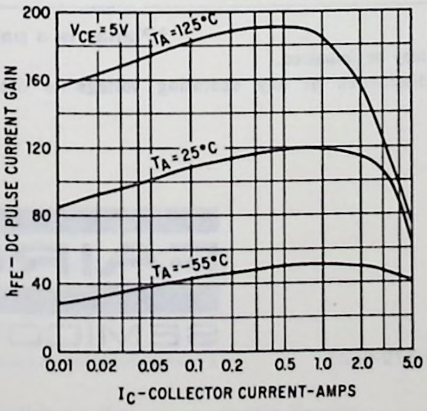
COLLECTOR CHARACTERISTICS* ACTIVE REGION



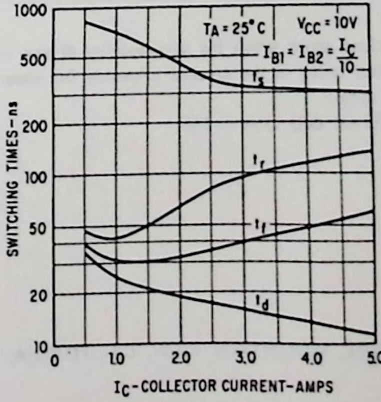
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT



*Single Family Characteristics on Transistor Curve Tracer.

2N5264

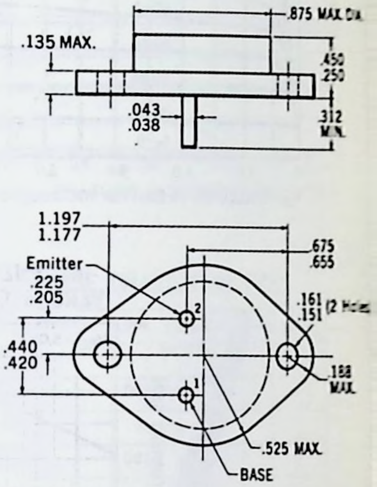
NPN HIGH VOLTAGE-HIGH CURRENT TRANSISTOR

DIFFUSED SILICON PLANAR* EPITAXIAL DEVICE

- **HIGH VOLTAGE . . . . 300 V BV_{CES}, 180 V LV_{CEO}**
- **HIGH CURRENT . . . MAX. $V_{CE(sat)}$ OF 1.25 V AT $I_C = 7.0$ A, $I_B = 0.7$ A**
- **HIGH SPEED . . . . . MAX. t_f OF 1.0 μs AT $I_C = 7.0$ A, $I_B = \pm 0.7$ A**

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-3) outline



NOTES: All dimensions in inches
Leads 1 and 2 electrically isolated from
Case is third electrical connection (Co
Leads are nickel alloy
Package weight 8.71 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		+200°C
Maximum Power Dissipation (Note 2)		
Total Dissipation at 25°C Case Temperature (See Safe Operating Area)		**87 Watts**
Junction to Case Thermal Resistance		2.0°C/W
Maximum Voltages and Currents		
V_{CBO}	Collector to Base Voltage	300 Volts
V_{CEO}	Collector to Emitter Voltage	180 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	10.0 Amps
I_B	Base Current	2.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
BV_{CES}	**Collector to Emitter Breakdown Voltage**	**300**			**Volts**	**$I_C = 1.0$ mA**	**$R_{BE} = 0\,\Omega$**
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage (Note 3)**		**0.60**	**1.25**	**Volts**	**$I_C = 7.0$ A**	**$I_B = 0.7$ A**
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		1.20	1.60	Volts	$I_C = 7.0$ A	$I_B = 0.7$ A
I_{CES}	Collector Cutoff Current		0.05	10	μA	$V_{CE} = 200$ V	$R_{BE} = 0\,\Omega$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
I_{EBO}	Emitter Cutoff Current		0.01	10	μA	$I_C = 0$	$V_{EB} = 4.0$ V
h_{FE}	DC Pulse Current Gain (Note 3)	30	125	300		$I_C = 1.0$ A	$V_{CE} = 2.5$ V
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage**	**180**			**Volts**	**$I_C = 20$ mA**	**$R_{BE} = \infty$**
I_{CES}(150°C)	Collector Cutoff Current		0.005	1.0	mA	$V_{CE} = 200$ V	$R_{BE} = 0\,\Omega$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		0.35	0.65	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		1.10	1.40	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
C_{cb}	Collector to Base Capacitance		55	80	pF	$I_E = 0$	$V_{CB} = 50$ V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.5	3.5			$I_C = 100$ mA	$V_{CE} = 10$ V
t_{on}	Turn On Time		0.40	1.0	μs	$I_C = 7.0$ A, $I_{B1} = I_{B2} = 0.7$ A	
t_{stg}	Storage Time		0.50	1.5	μs	$I_C = 7.0$ A, $I_{B1} = I_{B2} = 0.7$ A	
t_f	**Fall Time**		**0.40**	**1.0**	μs	**$I_C = 7.0$ A, $I_{B1} = I_{B2} = \pm 0.7$ A**	
t_{on}	Turn On Time			1.5	μs	$I_C = 1.0$ A, $I_{B1} = I_{B2} = 0.1$ A	
t_{stg}	Storage Time			2.5	μs	$I_C = 1.0$ A, $I_{B1} = I_{B2} = 0.1$ A	
t_f	Fall Time			1.5	μs	$I_C = 1.0$ A, $I_{B1} = I_{B2} = 0.1$ A	

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) The maximum power dissipation rating is the greatest allowable DC power. Maximum allowable power dissipation at any operating voltage is determined from the "Fo
Biased Safe Operating Area" curve.
(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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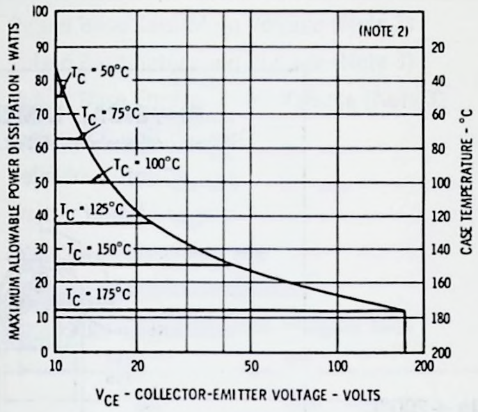
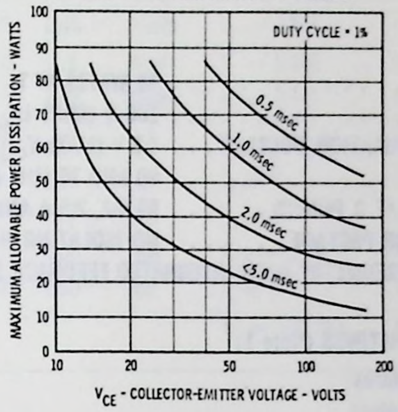
FAIRCHILD TRANSISTOR 2N5264

DC FORWARD BIASED SAFE OPERATING AREA

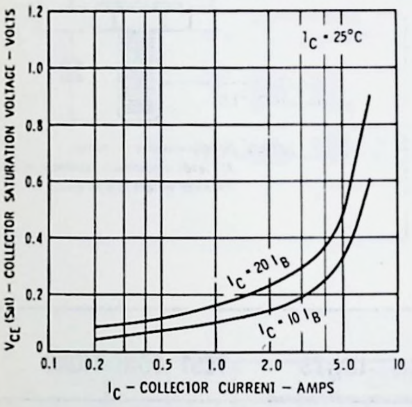


PULSED FORWARD BIASED SAFE OPERATING AREA

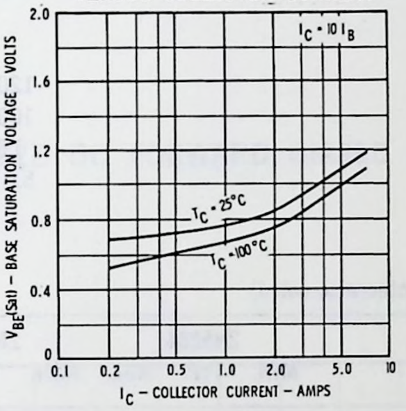


TYPICAL ELECTRICAL CHARACTERISTICS

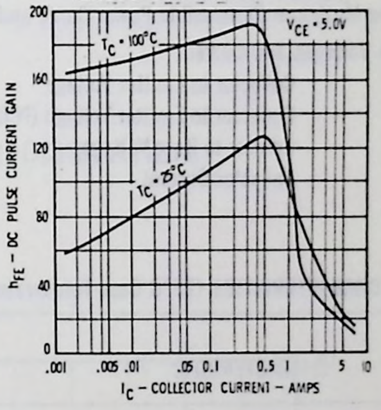
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



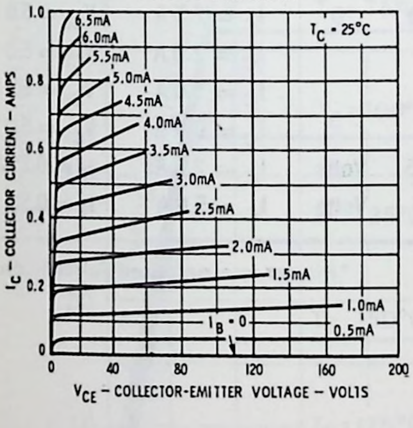
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



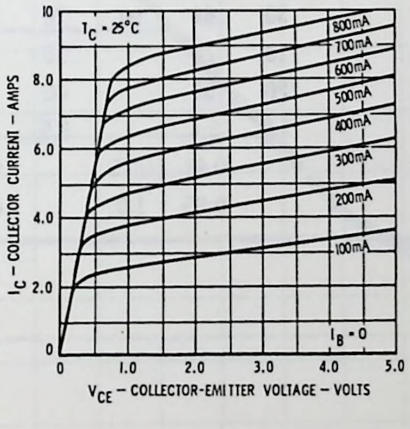
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



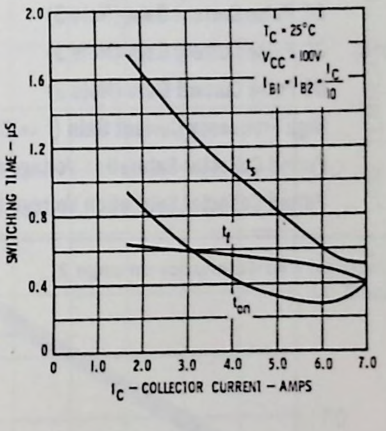
COLLECTOR CHARACTERISTICS ACTIVE REGION*



COLLECTOR CHARACTERISTICS SATURATION REGION*



SWITCHING TIME VERSUS COLLECTOR CURRENT



Single family characteristics on Transistor Curve Tracer.

2N5284 • 2N5285

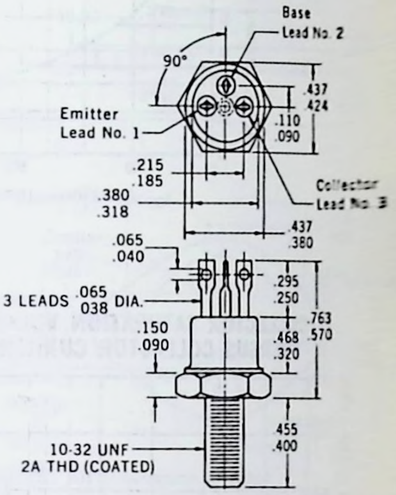
50 WATT NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5286 • 2N5287 FOR PNP COMPLEMENT

- **HIGH POWER . . . . 50 WATTS AT $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE . . . . 100 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . 1.5 V (MAX) $V_{CE(sat)}$ AT 5.0 A**
- **HIGH FREQUENCY . . . . 60 AND 70 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 50 mA, 2.5 A AND 5.0 A**
- **ISOLATED COLLECTOR PACKAGE . . . . NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
(in accordance with JEDEC TO-59 outline)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$ V (See Maximum Permissible Power Curve and Note 4)	50 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	120 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	100 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	5.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5284 MIN.	2N5284 TYP.	2N5284 MAX.	2N5285 MIN.	2N5285 TYP.	2N5285 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**100**			**100**			**Volts**	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	120			120			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**46**		**50**	**100**			$I_C = 50$ mA	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**64**	**90**	**70**	**114**	**200**		$I_C = 2.5$ A	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	26		35	50			$I_C = 2.5$ A	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**53**		**40**	**65**			$I_C = 5.0$ A	$V_{CE} = 5.0$ V
h_{fe}	**High Frequency Current Gain** (f = 20 MHz)	**3.0**	**3.4**		**3.5**	**4.4**			$I_C = 0.5$ A	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		0.43	0.75		0.43	0.75	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 3)		**0.85**	**1.5**		**0.85**	**1.5**	**Volts**	$I_C = 5.0$ A	$I_B = 0.5$ A

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild process

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FAIRCHILD TRANSISTORS 2N5284 • 2N5285

LECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N5284			2N5285					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		1.16	1.45		1.16	1.45	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		1.50	2.2		1.50	2.2	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(on)}$	Pulsed Base Emitter "ON" Voltage (Note 3)			1.45			1.45	Volts	$I_C = 2.5$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		0.007	1.0		0.007	1.0	μA	$V_{CE} = 80$ V	$V_{BE} = 0$
I_{CEO}	Collector Cutoff Current			50			50	μA	$I_B = 0$	$V_{CE} = 60$ V
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = 80$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance		90	250		90	250	pF	$I_E = 0$	$V_{CB} = 10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	20			20				$I_C = 100$ mA	$V_{CE} = 5.0$ V

OTES:

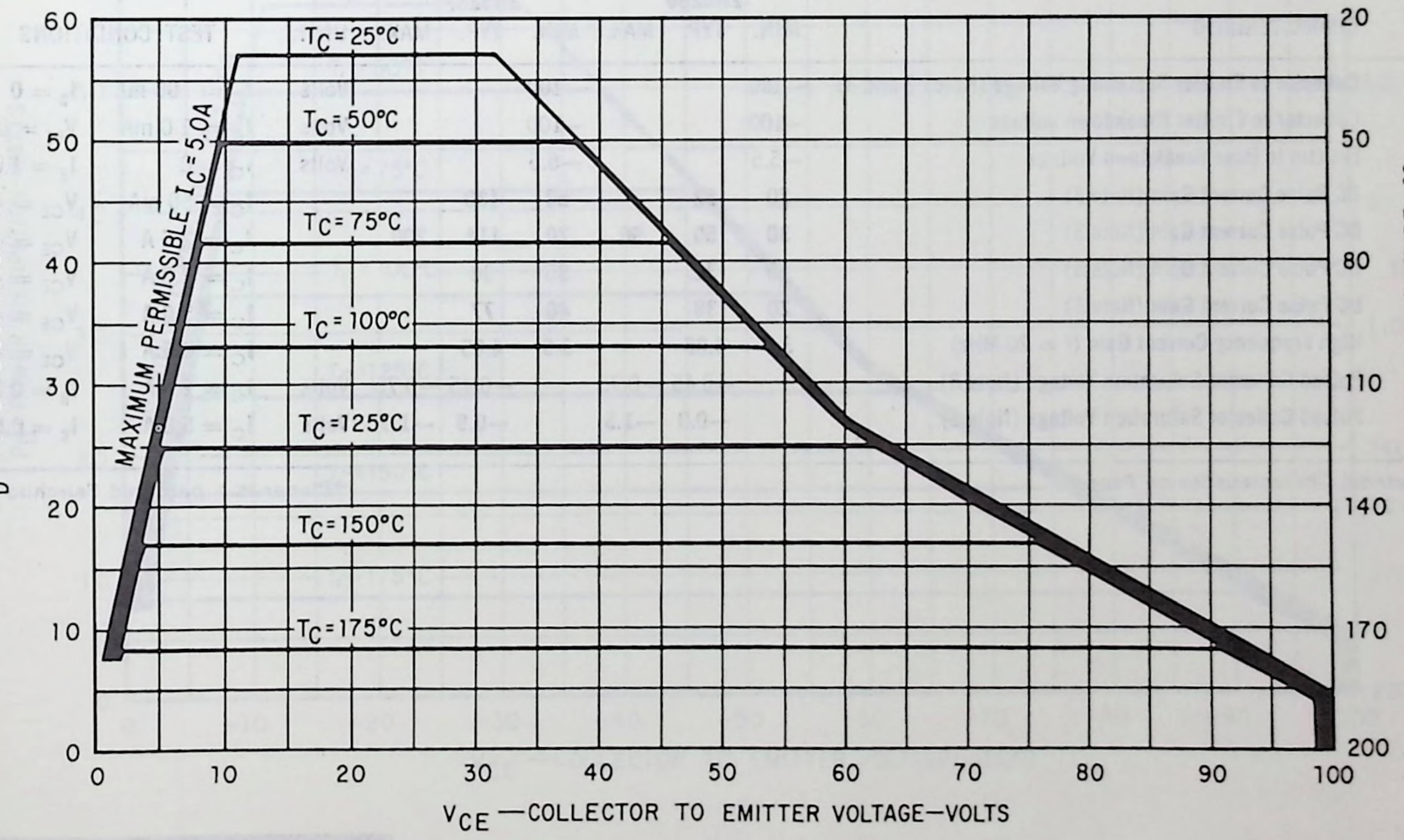
1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

2) This rating refers to a high current point where collector to emitter voltage is lowest.

3) Pulse Conditions: length = 300 μs; duty cycle = 1%.

4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION



2N5286 • 2N5287

50 WATT PNP POWER TRANSISTORS

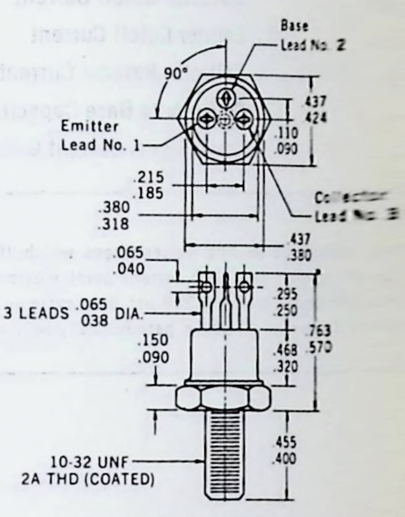
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5284 • 2N5285 FOR NPN COMPLEMENT

FEATURES

- **HIGH POWER . . . . 50 WATTS AT $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE . . . . —100 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . —1.5 V (MAX) $V_{CE(sat)}$ AT 5.0 A**
- **HIGH FREQUENCY . . . . 60 AND 70 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 50 mA, 2.5 A AND 5.0 A**
- **ISOLATED COLLECTOR PACKAGE . . . . NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
(in accordance with JEDEC TO-59 outline)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve and Note 4)	50 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	−100 Volts
V_{EBO}	Emitter to Base Voltage	−5.5 Volts
I_C	Collector Current	5.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5286 MIN.	2N5286 TYP.	2N5286 MAX.	2N5287 MIN.	2N5287 TYP.	2N5287 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	−100			−100			Volts	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−100			−100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.5			−5.5			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	20	52		50	130			$I_C = 50$ mA	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	30	50	90	70	114	200		$I_C = 2.5$ A	$V_{CE} = -5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	32		35	90			$I_C = 2.5$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	20	38		40	77			$I_C = 5.0$ A	$V_{CE} = -5.0$ V
h_{fe}	**High Frequency Current Gain** (f = 20 MHz)	3.0	4.05		3.5	4.85			$I_C = 0.5$ A	$V_{CE} = -5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		−0.45	−0.75		−0.45	−0.75	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 3)		−0.9	−1.5		−0.9	−1.5	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A

Additional Electrical Characteristics on Page 2
Notes on Page 2

*Planar is a patented Fairchild process

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FAIRCHILD TRANSISTORS 2N5286 • 2N5287

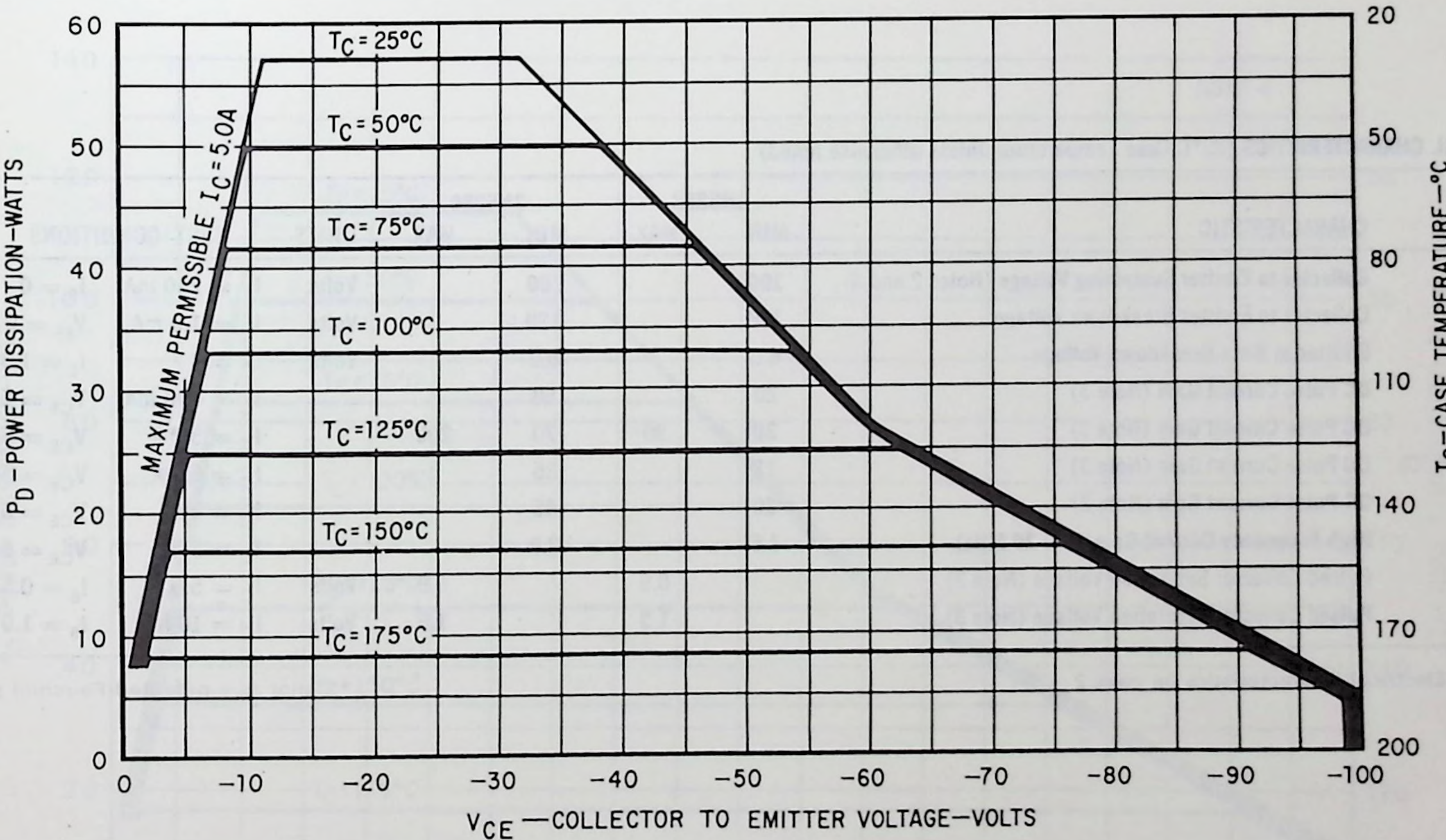
ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N5286			2N5287					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−1.1	−1.45		−1.1	−1.45	Volts	$I_C = 2.5$ A	$I_B = 0.25$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−1.55	−2.2		−1.55	−2.2	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(on)}$	Pulsed Base Emitter "ON" Voltage (Note 3)			−1.45			−1.45	Volts	$I_C = 2.5$ A	$V_{CE} = -5.0$ V
I_{CES}	Collector Cutoff Current		0.006	1.0		0.006	1.0	μA	$V_{CE} = -80$ V	$V_{BE} = 0$
I_{CEO}	Collector Cutoff Current			50			50	μA	$I_B = 0$	$V_{CE} = -60$ V
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{BE} = 4.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = -80$ V	$V_{BE} = 2.0$ V
C_{cb}	Collector to Base Capacitance		170	250		170	250	pF	$I_E = 0$	$V_{CB} = -10$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	20			20				$I_C = 100$ mA	$V_{CE} = -5.0$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest.
(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION



2N5288 • 2N5289

100 WATT NPN POWER TRANSISTORS

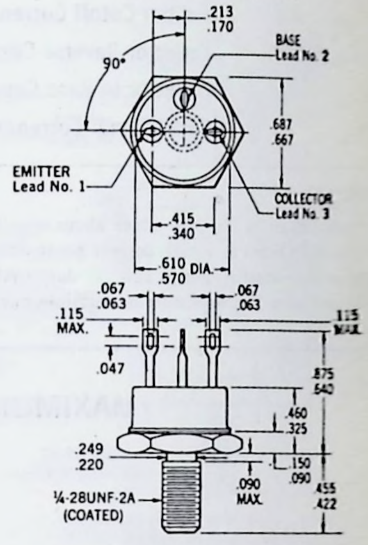
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5290 • 2N5291 FOR PNP COMPLEMENT

- **HIGH POWER . . . . 100 WATTS AT $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE . . . . 100 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . 1.5 V (MAX) $V_{CE(sat)}$ AT 10 A**
- **HIGH FREQUENCY . . . . 30 AND 40 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 100 mA, 5.0 A AND 10 A**
- **ISOLATED COLLECTOR PACKAGE . . . . . . NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS

Similar to JEDEC (TO-61)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 14.1 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)		+300°C
Maximum Power Dissipation		
Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$ V (See Maximum Permissible Power Curve and Note 4)		**100 Watts**
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	120 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	100 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	10 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5288 MIN.	2N5288 MAX.	2N5289 MIN.	2N5289 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**100**		**100**		**Volts**	$I_C = 200$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	120		120		Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**		**50**			$I_C = 100$ mA	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**90**	**70**	**200**		$I_C = 5.0$ A	$V_{CE} = 5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	12		35			$I_C = 5.0$ A	$V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**		**45**			$I_C = 10$ A	$V_{CE} = 5.0$ V
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**1.5**		**2.0**			$I_C = 2.0$ A	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		0.9		0.9	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 3)		**1.5**		**1.5**	**Volts**	$I_C = 10$ A	$I_B = 1.0$ A

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process

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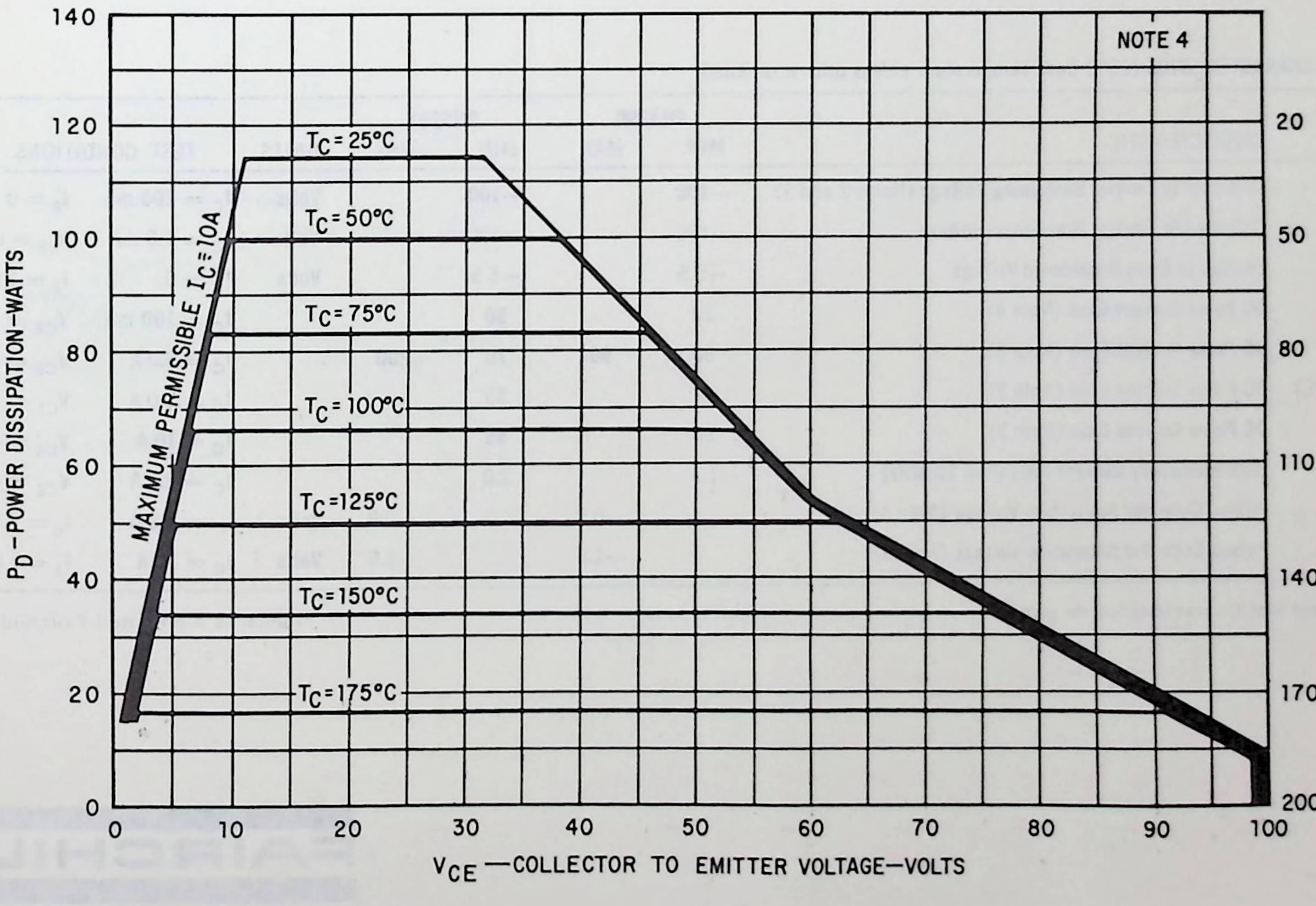
ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5288 MIN.	2N5288 MAX.	2N5289 MIN.	2N5289 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		1.8		1.8	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		2.2		2.2	Volts	$I_C = 10$ A	$I_B = 1.0$ A
$V_{BE(on)}$	Pulsed Base Emitter "ON" Voltage (Note 3)		1.8		1.8	Volts	$I_C = 5.0$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		1.0		1.0	μA	$V_{CE} = 80$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		1.0		1.0	μA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEX}(150°C)	Collector Reverse Current		500		500	μA	$V_{CE} = 80$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance		275		275	pF	$I_E = 0$	$V_{CB} = 10$ V
I_{CES}	Collector Cutoff Current		1.0		1.0	mA	$V_{CE} = 120$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		1.0		1.0	mA	$I_C = 0$	$V_{EB} = 6.0$ V
I_{CEO}	Collector Cutoff Current		50		50	μA	$I_B = 0$	$V_{CE} = 60$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	20		50			$I_C = 200$ mA	$V_{CE} = 5.0$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest.
(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION



2N5290 • 2N5291

100 WATT PNP POWER TRANSISTORS

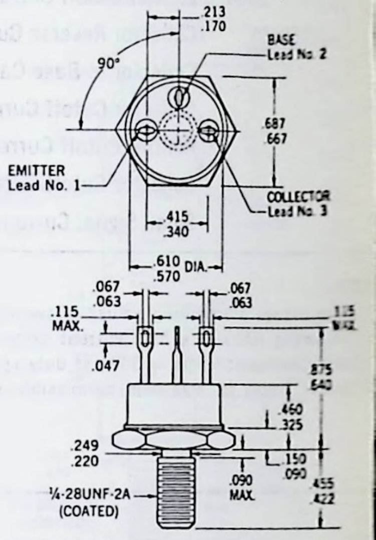
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

SEE 2N5288 • 2N5289 FOR NPN COMPLEMENT

- **HIGH POWER . . . . 100 WATTS AT $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE . . . . —100 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE . . . 1.5 V (MAX) $V_{CE(sat)}$ AT 10 A**
- **HIGH FREQUENCY . . . . 30 AND 40 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS . . . . . . 100 mA, 5.0 A AND 10 A**
- **ISOLATED COLLECTOR PACKAGE . . . . . . NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS

Similar to JEDEC (TO-61)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 14.1 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		−65°C to +200°C
Lead Temperature (Soldering, 60 seconds time limit)		+300°C
Maximum Power Dissipation		
Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve and Note 4)		**100 Watts**
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	−100 Volts
V_{EBO}	Emitter to Base Voltage	−5.5 Volts
I_C	Collector Current	10 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N5290		2N5291				
SYMBOL	CHARACTERISTIC	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	−100		−100		Volts	$I_C = 200$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−100		−100		Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.5		−5.5		Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	20		50			$I_C = 100$ mA	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	30	90	70	200		$I_C = 5.0$ A	$V_{CE} = -5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	12		35			$I_C = 5.0$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	20		45			$I_C = 10$ A	$V_{CE} = -5.0$ V
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	1.5		2.0			$I_C = 2.0$ A	$V_{CE} = -5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		−0.9		−0.9	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 3)		−1.5		−1.5	Volts	$I_C = 10$ A	$I_B = 1.0$ A

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process

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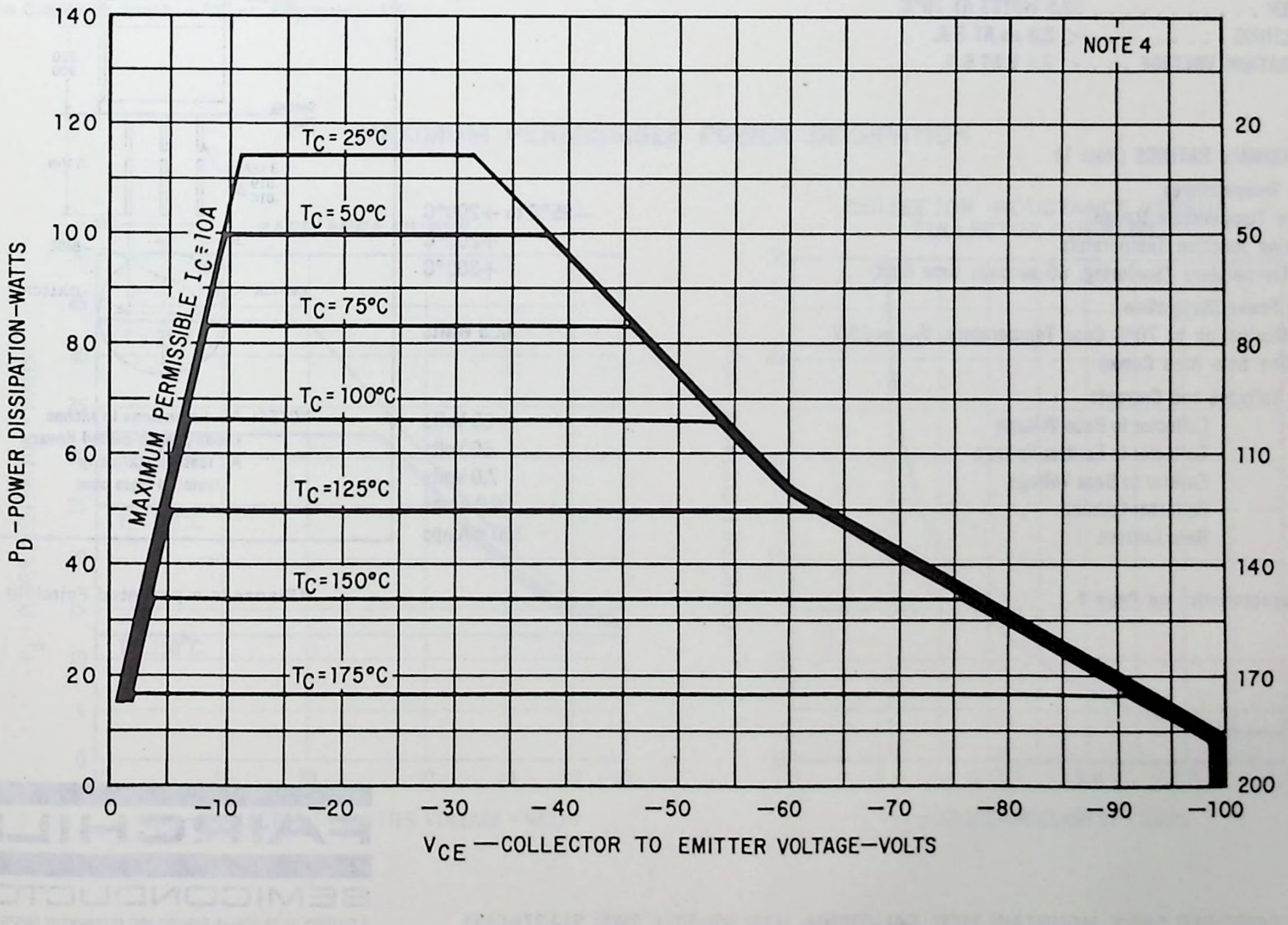
FAIRCHILD TRANSISTORS 2N5290 • 2N5291

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5290 MIN.	2N5290 MAX.	2N5291 MIN.	2N5291 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−1.8		−1.8	Volts	$I_C = 5.0$ A	$I_B = 0.5$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−2.2		−2.2	Volts	$I_C = 10$ A	$I_B = 1.0$ A
$V_{BE(on)}$	Pulsed Base Emitter "ON" Voltage (Note 3)		−1.8		−1.8	Volts	$I_C = 5.0$ A	$V_{CE} = -5.0$ V
I_{CES}	Collector Cutoff Current		1.0		1.0	μA	$V_{CE} = -80$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		1.0		1.0	μA	$I_C = 0$	$V_{EB} = -4.0$ V
I_{CEX}(150°C)	Collector Reverse Current		500		500	μA	$V_{CE} = -80$ V	$V_{EB} = -2.0$ V
C_{cb}	Collector to Base Capacitance		500		500	pF	$I_E = 0$	$V_{CB} = -10$ V
I_{CES}	Collector Cutoff Current		1.0		1.0	mA	$V_{CE} = -100$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current		1.0		1.0	mA	$I_C = 0$	$V_{EB} = -5.5$ V
I_{CEO}	Collector Cutoff Current		50		50	μA	$I_B = 0$	$V_{CE} = -60$ V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	20		50			$I_C = 200$ mA	$V_{CE} = -5.0$ V

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest.
(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

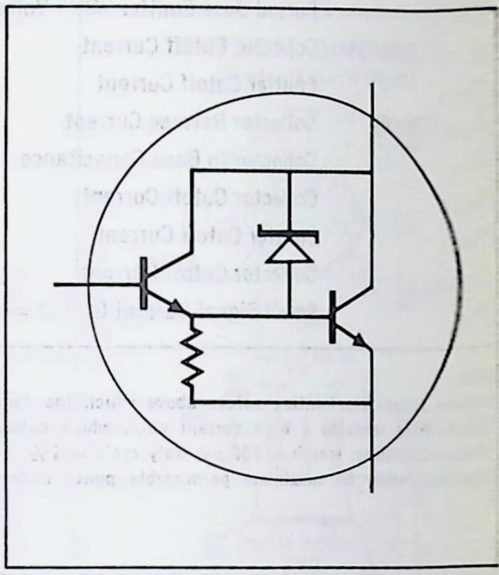


2N5425 • 2N5426

NPN POWER INDUCTIVE LOAD DRIVERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — The 2N5425 and 2N5426 are monolithic darlington transistors with integrated base to emitter resistors added for stability. The output devices are of the discrete emitter technology for high forward biased safe operating area. Clamping is achieved by means of a hybrid zener diode connected from collector to base on the output device. These transistors are housed in a special BeO based TO-9 package for higher power dissipation capability.



A SELF-CLAMPED MONOLITHIC DARLINGTON INDUCTIVE LOAD DRIVER

SPECIFICALLY DESIGNED TO DRIVE:

- **Solenoid Hammers**
- **Relays**
- **Stepping Motors**

WITH THE FOLLOWING SPECIAL FEATURES:

- **Integrated Circuit Compatibility — 5 mA Drives 5 Amps**
- **Zener Clamping — At 60 Volts Minimum**
- **Base-Emitter Termination — R_{BE} 100 Ohms Nominal**
- **Special Low R_{TH} Beryllia Based TO-9**

- **HIGH CURRENT . . . . 5 AMPS**
- **HIGH VOLTAGE . . . . > 60 VOLTS**
- **HIGH GAIN . . . . > 1000 AT 5 A.**
- **HIGH POWER . . . . 32.5 WATTS AT 70°C**
- **FAST SWITCHING . . . . < 2.0 μs AT 5 A.**
- **LOW SATURATION VOLTAGE . . . < 2.5 V AT 5 A.**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature Range	−65°C to +200°C
Operating Junction Temperature	+200°C
Lead Temperature (Soldering, 60 seconds time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 70°C Case Temperature, $V_{CE} = 25$ V (See Safe Area Curve)	32.5 Watts

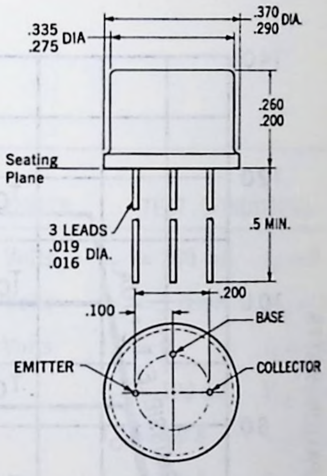
Maximum Voltages and Currents

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage	60 Volts
V_{EBO}	Emitter to Base Voltage	7.0 Volts
I_C	Collector Current	5.0 Amps
I_B	Base Current	100 mAmps

Electrical Characteristics on Page 2.

PHYSICAL DIMENSIONS

In Accordance With
JEDEC (TO-9) Outline



NOTES: All dimensions in inches
Leads are tin-plated Kovar
All leads electrically
isolated from case

*Planar is a patented Fairchild process

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FAIRCHILD TRANSISTORS 2N5425 • 2N5426

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5426			2N5425			UNITS	TEST CONDITIONS
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	60			60			Volts	$I_C = 50$ mA, $I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0			7.0			Volts	$I_C = 0$, $I_E = 100$ μA
BV_{CEX}	Collector to Emitter Breakdown Voltage ($T_C = 70°C$) (Fig. 1)	60			60			Volts	$I_C = 5.0$ A, $V_{BE} = \leq 0.3$ V
I_{CBO}	Collector Cutoff Current			1.0			1.0	μA	$V_{CB} = 50$ V, $I_E = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$V_{EB} = 5.0$ V, $I_C = 0$
I_{CEO}	Collector Leakage Current			10			10	μA	$V_{CE} = 50$ V, $I_B = 0$
I_{CES}	Collector Leakage Current ($T_C = 150°C$)			1.0			1.0	mA	$V_{CE} = 50$ V, $V_{BB} = 0$
t_{on}	Turn On Time (Fig. 2)			300			300	ns	$I_C = 5$ A, $I_B = 10$ mA
t_{off}	Turn Off Time (Fig. 2)			2000			2000	ns	$I_C = 5$ A, $I_{B1} = I_{B2} = 10$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Notes 2 & 3)	1.4	1.8	2.2				Volts	$I_C = 5.0$ A, $I_B = 5.0$ mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Notes 2 & 3)					2.2	2.5	Volts	$I_C = 5.0$ A, $I_B = 10$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 2 & 3)	1.5		2.5				Volts	$I_C = 5.0$ A, $I_B = 5.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Notes 2 & 3)						3.0	Volts	$I_C = 5.0$ A, $I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.5	20		2.5	20			$I_C = 500$ mA, $V_{CE} = 10$ V
C_{cb}	Collector to Base Capacitance		8	15			15	pF	$V_{CB} = 10$ V, $I_E = 0$
C_{eb}	Emitter to Base Capacitance		25	50			50	pF	$V_{EB} = 0.5$ V, $I_C = 0$

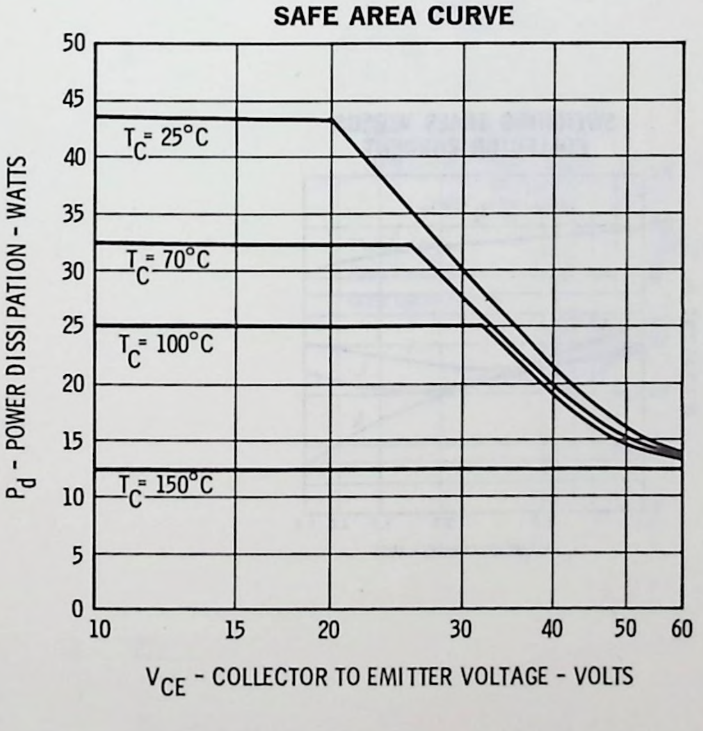
NOTES:

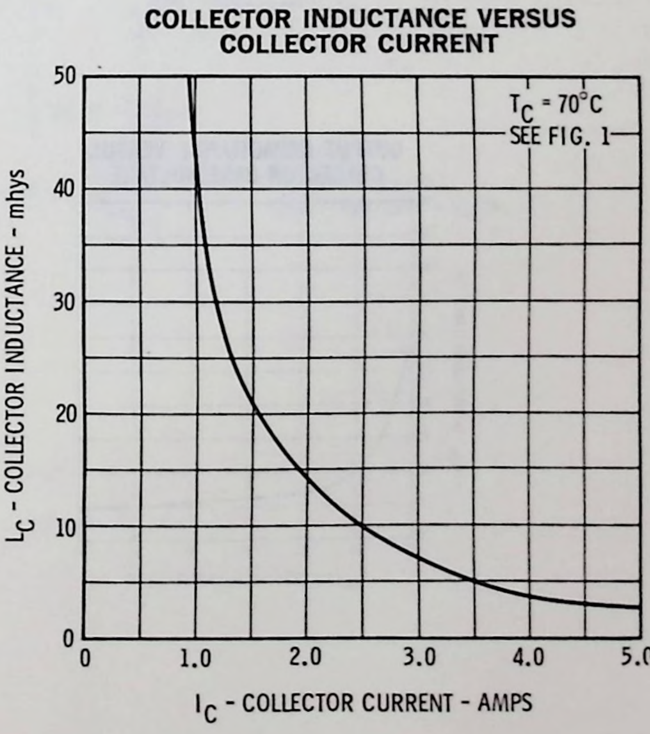
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) Point of measurement: ¼" from header.

(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.

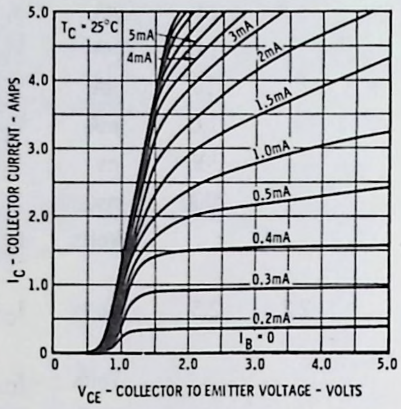
MAXIMUM PERMISSIBLE POWER DISSIPATION


SAFE AREA CURVE

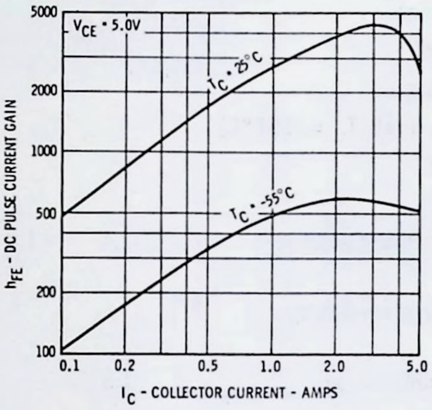

COLLECTOR INDUCTANCE VERSUS COLLECTOR CURRENT

TYPICAL ELECTRICAL CHARACTERISTICS
2N5425 • 2N5426

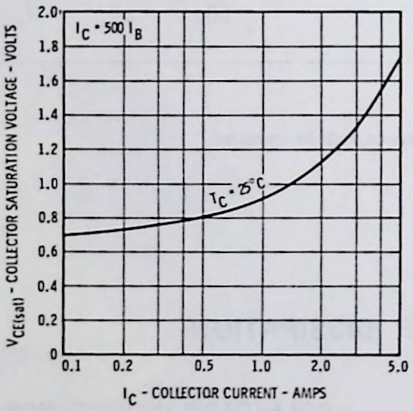
COLLECTOR CHARACTERISTICS SATURATION REGION



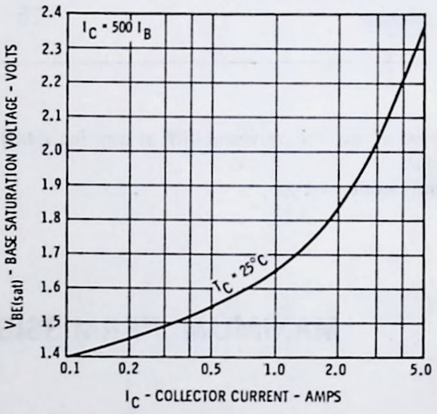
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



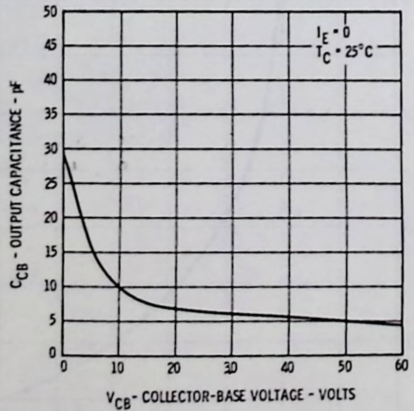
COLLECTOR SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



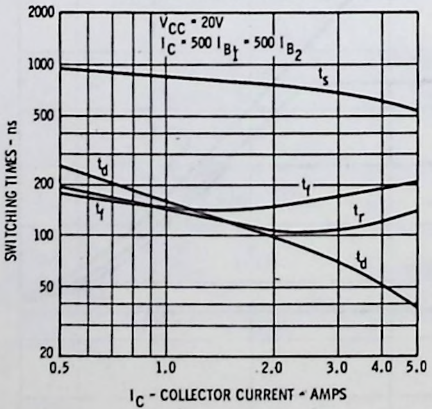
BASE SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



OUTPUT CAPACITANCE VERSUS COLLECTOR-BASE VOLTAGE

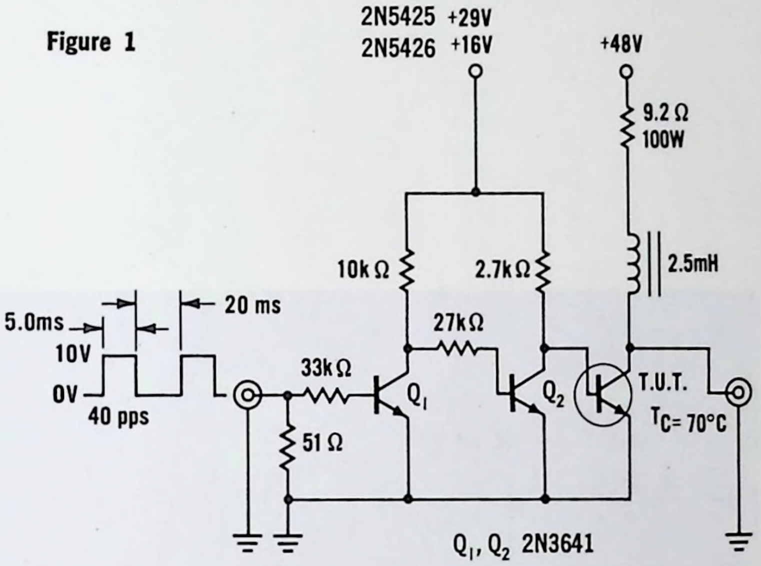


SWITCHING TIMES VERSUS COLLECTOR CURRENT



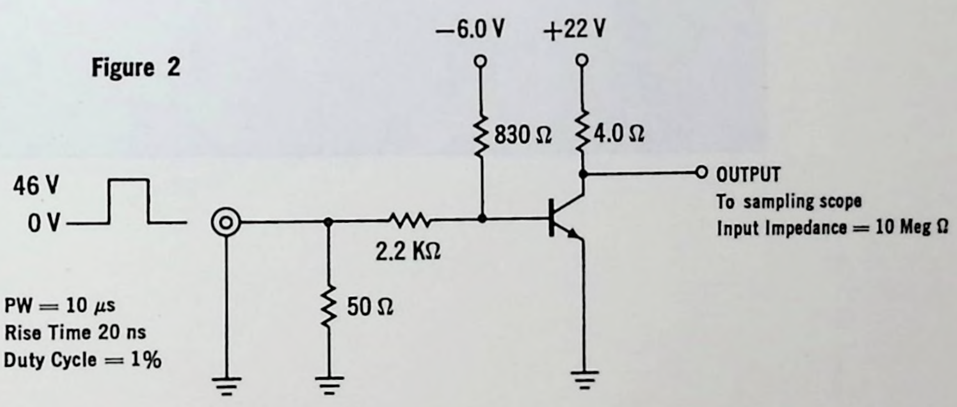
INDUCTIVE TEST CIRCUIT

Figure 1


2N5425 +29V
2N5426 +16V
+48V
9.2 Ω
100W
10k Ω
2.7k Ω
2.5mH
5.0ms
20 ms
10V
0V
40 pps
27kΩ
33kΩ
Q₁
Q₂
T.U.T.
T_C= 70°C
51 Ω
Q₁, Q₂ 2N3641

SWITCHING TIME TEST CIRCUIT

Figure 2


−6.0 V
+22 V
830 Ω
4.0 Ω
OUTPUT
To sampling scope
Input Impedance = 10 Meg Ω
46 V
0 V
2.2 KΩ
50 Ω
PW = 10 μs
Rise Time 20 ns
Duty Cycle = 1%

Silicon Controlled Rectifiers

SCR OPERATION ADVANTAGES AND RELIABILITY

Fairchild has produced Silicon Controlled Rectifiers since 1964. Because all Fairchild Thyristors are made by the PLANAR* process, they offer the user the following advantages in operating characteristics and reliability.

Operation Advantages

Consistently higher maximum operating junction temperatures (T_j MAX = 150°C) allow operation of Fairchild thyristors over a wider range of ambient temperature excursion without sacrificing blocking voltage, forward current, or gate triggering abilities.

Lower blocking (leakage) currents allow lower gate trigger currents in the thyristor and reduce the power loss during the non-conducting or blocking state.

Increased gate sensitivity allows control of higher load currents with lower gate trigger currents. This results in higher power gain and increased design flexibility for the triggering circuit.

Reliability

Reliability of a semiconductor depends on the susceptibility of a given junction to ambient influences within the encapsulation. The passivation techniques of the PLANAR process prohibit external influences from contaminating and degrading the junction surface, thus insuring longtime reliability.

The long term stability of the PLANAR passivated junctions allows more exacting circuit design and reduces circuit drift with time.

PLANAR SILICON CONTROLLED RECTIFIER SELECTION GUIDE

Current Category	Package	D.C. Forward Current @ T_{MAX} Amp @ °C	Max. Gate Trigger Current @ 25°C mA	Rated Frwd. & Rev. Blocking Voltage Volts	FSC Type Number
0.5 Amp	TO - 46	0.40 @ 85° Case	0.20	50	2N4096
				100	2N4097
				200	2N4098
		0.25 @ 75° Case	0.05	15	2N892
				30	2N894
				60	2N896
				100	2N898
				200	2N900
		0.26 @ 125° Case	0.02	30	2N948
				60	2N949
				100	2N950
				200	2N951
	TO - 18	0.35 @ 100° Case	0.20	15	2N876
				30	2N877
				60	2N878
				100	2N879
				150	2N880
				200	2N881
				300	2N882
			0.02	15	2N884
				30	2N885
				60	2N886
				100	2N887
				150	2N888
				200	2N889
				300	2N890
		0.40 @ 85° Case	0.20	50	2N4108
				100	2N4109
				200	2N4110
		1.25 @ 85° Case	0.10	25	2N4212
				50	2N4213
				100	2N4214
				150	2N4215
				200	2N4216
				250	2N4217
				300	2N4218
2.0 Amp	TO - 5	1.25 @ 100° Case	2.0	30	FT1881
				60	FT1882
				100	FT1883
				150	FT1884
				200	FT1885
			0.20	15	FT1869
				30	FT1870
				60	FT1871
				100	FT1872
				150	FT1873
				200	FT1874

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* Planar is a patented Fairchild process.

PLANAR SILICON CONTROLLED RECTIFIER SELECTION GUIDE

Current Category	Package	D.C. Forward Current @ T_{MAX} Amp @ °C	Max. Gate Trigger Current @ 25°C mA	Rated Frwd. & Rev. Blocking Voltage Volts	FSC Type Number
		1.30 @ 80° Case	0.20	25	FT2009
				50	FT2010
				100	FT2011
				200	FT2012
				300	FT2013
4.0 Amp	TO - 5	1.60 @ 85° Case	0.10	25	2N2322
				50	2N2323
				100	2N2324
				150	2N2325
				200	2N2326
				250	2N2327
				300	2N2328
			.025	25	2N2322A
				50	2N2323A
				100	2N2324A
				150	2N2325A
				200	2N2326A
				250	2N2327A
				300	2N2328A

SUGGESTED FAIRCHILD PLANAR EQUIVALENTS

The following are all released EIA registered thyristors which Fairchild offers, or for which a close equivalent is offered.

Where Fairchild does not offer the registered type, an equivalent is suggested based on approximate forward current rating, same or closest equivalent package, blocking voltage and gate sensitivity.

All FT numbered types are identical to EIA registered types except for s package differences (EIA TO-9 or isolated case TO-5 versus FSC TO-5 anode connected to case).

EIA		FSC Equiv.		EIA		FSC Equiv.		EIA		FSC Equiv.	
Type	Pkg.	Type	Pkg.	Type	Pkg.	Type	Pkg.	Type	Pkg.	Type	Pkg.
2N876	TO - 18	2N876	TO - 18	2N1884	TO - 9	FT1884	TO - 5	2N3005	TO - 18	2N4108	TO - 18
2N877	TO - 18	2N877	TO - 18	2N1885	TO - 9	FT1885	TO - 5	2N3006	TO - 18	2N4109	TO - 18
2N878	TO - 18	2N878	TO - 18	2N2009	Isol. Case	FT2009	TO - 5	2N3007	TO - 18	2N4109	TO - 18
2N879	TO - 18	2N879	TO - 18	2N2010	TO - 5	FT2010	TO - 5	2N3008	TO - 18	2N4110	TO - 18
2N880	TO - 18	2N880	TO - 18	2N2011	TO - 5	FT2011	TO - 5	2N3027	TO - 18	2N4108	TO - 18
2N881	TO - 18	2N881	TO - 18	2N2012	TO - 5	FT2012	TO - 5	2N3028	TO - 18	2N4109	TO - 18
2N882	TO - 18	2N882	TO - 18	2N2013	Isol. Case	FT2013	TO - 5	2N3029	TO - 18	2N4109	TO - 18
2N884	TO - 18	2N884	TO - 18	2N2322	TO - 5	2N2322	TO - 5	2N3030	TO - 18	2N885	TO - 18
2N885	TO - 18	2N885	TO - 18	2N2322A	TO - 5	2N2322A	TO - 5	2N3031	TO - 18	2N886	TO - 18
2N886	TO - 18	2N886	TO - 18	2N2323	TO - 5	2N2323	TO - 5	2N3032	TO - 18	2N887	TO - 18
2N887	TO - 18	2N887	TO - 18	2N2323A	TO - 5	2N2323A	TO - 5	2N3254	TO - 46	2N884	TO - 18
2N888	TO - 18	2N888	TO - 18	2N2324	TO - 5	2N2324	TO - 5	2N3255	TO - 46	2N885	TO - 18
2N889	TO - 18	2N889	TO - 18	2N2324A	TO - 5	2N2324A	TO - 5	2N3256	TO - 46	2N886	TO - 18
2N890	TO - 18	2N890	TO - 18	2N2325	TO - 5	2N2325	TO - 5	2N3257	TO - 46	2N4096	TO - 46
2N892	TO - 18	2N892	TO - 18	2N2325A	TO - 5	2N2325A	TO - 5	2N3258	TO - 46	2N4096	TO - 46
2N894	TO - 18	2N894	TO - 18	2N2326	TO - 5	2N2326	TO - 5	2N3259	TO - 46	2N4097	TO - 46
2N896	TO - 18	2N896	TO - 18	2N2326A	TO - 5	2N2326A	TO - 5	2N3555	TO - 5	2N2323A	TO - 5
2N898	TO - 18	2N898	TO - 18	2N2327	TO - 5	2N2327	TO - 5	2N3556	TO - 5	2N2324A	TO - 5
2N900	TO - 18	2N900	TO - 18	2N2327A	TO - 5	2N2327A	TO - 5	2N3557	TO - 5	2N2324A	TO - 5
2N948	TO - 18	2N948	TO - 18	2N2328	TO - 5	2N2328	TO - 5	2N3558	TO - 5	2N2326A	TO - 5
2N949	TO - 18	2N949	TO - 18	2N2328A	TO - 5	2N2328A	TO - 5	2N3559	TO - 5	2N2323	TO - 5
2N950	TO - 18	2N950	TO - 18	2N2344	TO - 5	2N2322A	TO - 5	2N3560	TO - 5	2N2324	TO - 5
2N951	TO - 18	2N951	TO - 18	2N2345	TO - 5	2N2323A	TO - 5	2N3561	TO - 5	2N2324	TO - 5
2N1869	TO - 9	FT1869	TO - 5	2N2346	TO - 5	2N2324A	TO - 5	2N3562	TO - 5	2N2326	TO - 5
2N1870	TO - 9	FT1870	TO - 5	2N2347	TO - 5	2N2325A	TO - 5	2N4096	TO - 46	2N4096	TO - 46
2N1870A'	TO - 9	FT1870	TO - 5	2N2348	TO - 5	2N2326A	TO - 5	2N4097	TO - 46	2N4097	TO - 46
2N1871	TO - 9	FT1871	TO - 5	2N2679	TO - 18	2N885	TO - 18	2N4098	TO - 46	2N4098	TO - 46
2N1871A'	TO - 9	FT1871	TO - 5	2N2680	TO - 18	2N886	TO - 18	2N4108	TO - 18	2N4108	TO - 18

SUGGESTED FAIRCHILD PLANAR EQUIVALENTS

EIA		FSC Equiv.		EIA		FSC Equiv.		EIA		FSC Equiv.	
Type	Pkg.	Type	Pkg.	Type	Pkg.	Type	Pkg.	Type	Pkg.	Type	Pkg.
2N1872	TO - 9	FT1872	TO - 5	2N2681	TO - 18	2N887	TO - 18	2N4109	TO - 18	2N4109	TO - 18
2N1872A[1]	TO - 9	FT1872	TO - 5	2N2682	TO - 18	2N889	TO - 18	2N4110	TO - 18	2N4110	TO - 18
2N1873	TO - 9	FT1873	TO - 5	2N2683[2]	TO - 18	2N885	TO - 18	2N4144	TO - 52	2N4108	TO - 18
2N1874	TO - 9	FT1874	TO - 5	2N2684[2]	TO - 18	2N886	TO - 18	2N4145	TO - 52	2N4108	TO - 18
2N1874A[1]	TO - 9	FT1874	TO - 5	2N2685[2]	TO - 18	2N887	TO - 18	2N4146	TO - 52	2N4109	TO - 18
2N1875[1]	TO - 9	2N2322A	TO - 5	2N2686[2]	TO - 18	2N889	TO - 18	2N4147	TO - 52	2N4109	TO - 18
2N1876[1]	TO - 9	2N2323A	TO - 5	2N2687	TO - 18	2N4108	TO - 18	2N4148	TO - 52	2N4110	TO - 18
2N1877[1]	TO - 9	2N2324A	TO - 5	2N2688	TO - 18	2N4109	TO - 18	2N4149	TO - 52	2N4110	TO - 18
2N1878[1]	TO - 9	2N2324A	TO - 5	2N2689	TO - 18	2N4109	TO - 18	2N4212	TO - 5	2N4212	TO - 5
2N1879[1]	TO - 9	2N2325A	TO - 5	2N2690	TO - 18	2N4110	TO - 18	2N4213	TO - 5	2N4213	TO - 5
2N1880[1]	TO - 9	2N2326A	TO - 5	2N3001	TO - 18	2N885	TO - 18	2N4214	TO - 5	2N4214	TO - 5
2N1881	TO - 9	FT1881	TO - 5	2N3002	TO - 18	2N886	TO - 18	2N4215	TO - 5	2N4215	TO - 5
2N1882	TO - 9	FT1882	TO - 5	2N3003	TO - 18	2N887	TO - 18	2N4216	TO - 5	2N4216	TO - 5
2N1883	TO - 9	FT1883	TO - 5	2N3004	TO - 18	2N889	TO - 18	2N4217	TO - 5	2N4217	TO - 5
								2N4218	TO - 5	2N4218	TO - 5

SILICON CONTROLLED RECTIFIER NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
2N876	9-1	FT1869	9-9	2N2325	9-15
2N877	9-1	FT1870	9-9	2N2325A	9-15
2N878	9-1	FT1871	9-9	2N2326	9-15
2N879	9-1	FT1872	9-9	2N2326A	9-15
2N880	9-1	FT1873	9-9	2N2327	9-15
2N881	9-1	FT1874	9-9	2N2327A	9-15
2N882	9-1	FT1881	9-11	2N2328	9-15
2N884	9-3	FT1882	9-11	2N2328A	9-15
2N885	9-3	FT1883	9-11	2N2329	9-15
2N886	9-3	FT1884	9-11	2N2329A	9-15
2N887	9-3	FT1885	9-11	2N4096	9-17
2N888	9-3	FT2009	9-13	2N4097	9-17
2N889	9-3	FT2010	9-13	2N4098	9-17
2N890	9-3	FT2011	9-13	2N4108	9-21
2N892	9-5	FT2012	9-13	2N4109	9-21
2N894	9-5	FT2013	9-13	2N4110	9-21
2N896	9-5	FT2014	9-13	2N4212	9-25
2N898	9-5	2N2322	9-15	2N4213	9-25
2N900	9-5	2N2322A	9-15	2N4214	9-25
2N948	9-7	2N2323	9-15	2N4215	9-25
2N949	9-7	2N2323A	9-15	2N4216	9-25
2N950	9-7	2N2324	9-15	2N4217	9-25
2N951	9-7	2N2324A	9-15	2N4218	9-25

2N876 THROUGH 2N882

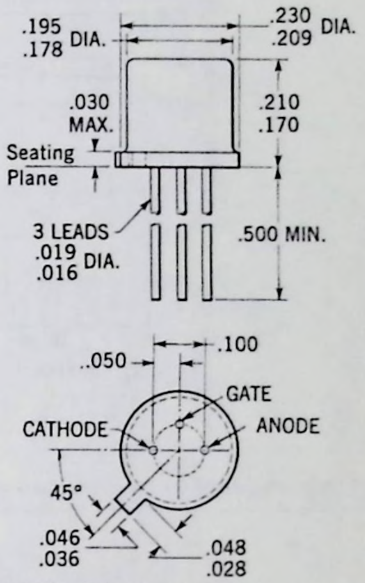
PNPN SILICON CONTROLLED RECTIFIERS

DIFFUSED SILICON PLANAR* THYRISTORS

- FORWARD CURRENT RATING OF 0.35 AMPS DC AT $T_C = 100°C$
- BLOCKING VOLTAGE CAPABILITY TO 300 VOLTS
- MAXIMUM GATE TRIGGER CURRENT OF 200 μA AT $T_C = 25°C$
- RELIABLE PLANAR CONSTRUCTION

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Anode internally connected to case
Package weight is 0.43 grams

BSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures				
†Storage Temperature				−65°C to +150°C
†Operating Temperature				−65°C to +150°C
†Lead Temperature (Soldering, 10 second time limit)				+230°C
Maximum Currents				
RMS Forward Current (180° Conduction Angle) (Note 2)	$T_C = 100°C$ $T_A = 25°C$	$I_{F(RMS)}$		430 mA 300 mA
Continuous Forward Current (Note 2)	†$T_C = 100°C$ $T_A = 25°C$	$I_{F(DC)}$		350 mA 240 mA
Average Forward Current (180° Conduction Angle) (Note 2)	$T_C = 100°C$ $T_A = 25°C$	$I_{F(AV)}$		280 mA 192 mA
†Peak Recurrent Forward Current (Repetition rate of 60 pps or higher, ≤ 0.01 duty cycle)	$T_C = 100°C$	I_{FRM}		20 Amps
†Surge Current (Rectangular pulse of 0.2 ms duration, peak)	$T_C = 100°C$	$I_{FM(surge)}$		20 Amps
†Peak Forward Gate Current	$T_C = 100°C$	I_{GFM}		250 mA
Maximum Voltages ($T_C = -65°C$ to $+100°C$)				
†Peak Reverse Gate Voltage		V_{GRM}		5.0 Volts
†DC Forward and Reverse Blocking Voltage		V_{FM}, V_{RM}	2N876	15 Volts
			2N877	30 Volts
			2N878	60 Volts
			2N879	100 Volts
			2N880	150 Volts
			2N881	200 Volts
			2N882	300 Volts

LECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
†I_{FX}	Forward Blocking Current		0.004	10	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$
†I_{FX}(125°C)	Forward Blocking Current		1.5	100	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$
†I_{RX}	Reverse Blocking Current		0.004	10	μA	V_{AK} = Rated V_{RM}, $R_{GK} = 1.0\ k\Omega$
†I_{RX}(125°C)	Reverse Blocking Current		1.5	100	μA	V_{AK} = Rated V_{RM}, $R_{GK} = 1.0\ k\Omega$
†I_{GR}	Reverse Gate Current (except 2N882)		0.1	10	μA	$V_{GK} = -2.0\ V$, $I_A = 0$
†I_{GR}	Reverse Gate Current (2N882 only)		0.1	10	μA	$V_{GK} = -5.0\ V$, $I_A = 0$
†I_{GT}	Gate Trigger Current		100	200	μA	$V_{AA} = 5.0\ V$, $R_L = 100\ \Omega$, $R_{GS} = 10\ k\Omega$
†V_{GT}	Gate Trigger Voltage	0.40	0.64	0.80	Volts	$V_{AA} = 5.0\ V$, $R_L = 100\ \Omega$, $R_{GS} = 100\ \Omega$
†I_{HX}	Holding Current		1.4	5.0	mA	$V_{AA} = 5.0\ V$, $I_G = -150\ \mu A$
†V_F	On Voltage (Note 3)		1.0	1.5	Volts	$I_F = 200\ mA$
dV/dt	Critical Rate Of Rise Of Anode Voltage		95		V/μs	V_{AA} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$

†JEDEC Registered Values

*Planar is a patented Fairchild process.

OTES:

1) These ratings are limiting values above which the reliability of the device may be impaired.
2) These ratings give a maximum junction temperature of 150°C with the maximum average power dissipation and a maximum junction to case thermal resistance of 44.5°C/Watt and a junction to ambient thermal resistance of 350°C/Watt.
3) Pulse Conditions: Length = 300 μs; Duty Cycle ≤ 2%.
4) Ambient temperature derating curves are derived with no external heat sink connected.

FAIRCHILD
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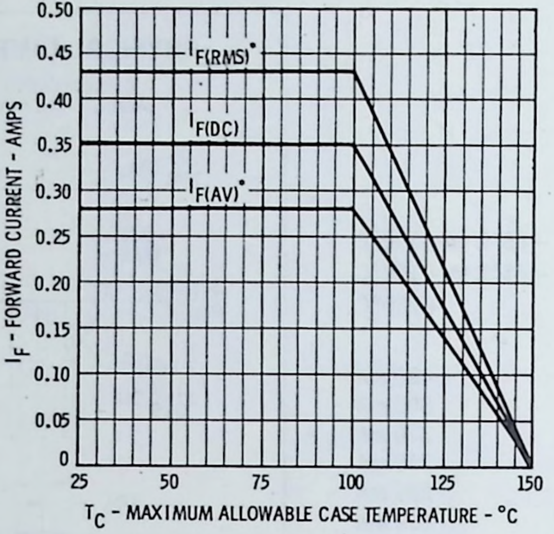
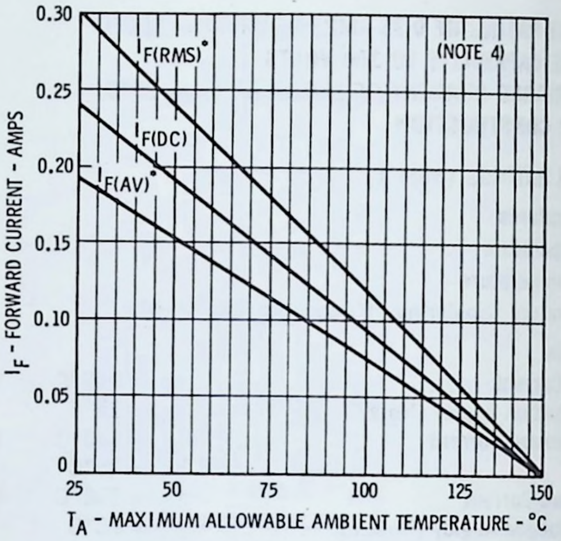
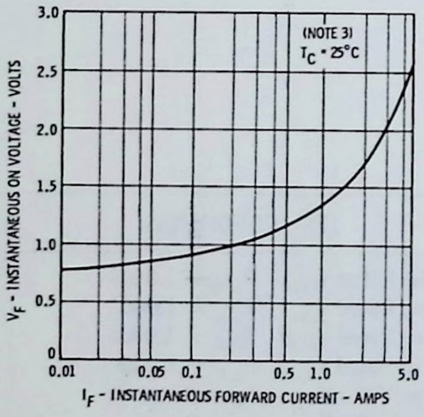
MAXIMUM RATINGS

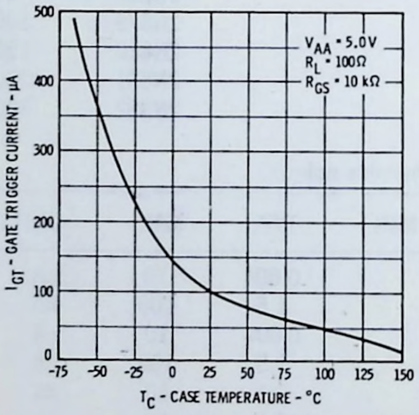

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE HALF WAVE CONDUCTION*

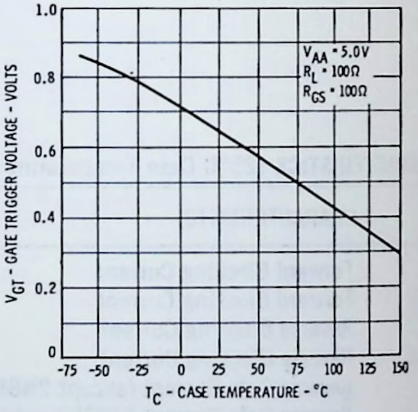

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE HALF WAVE CONDUCTION*

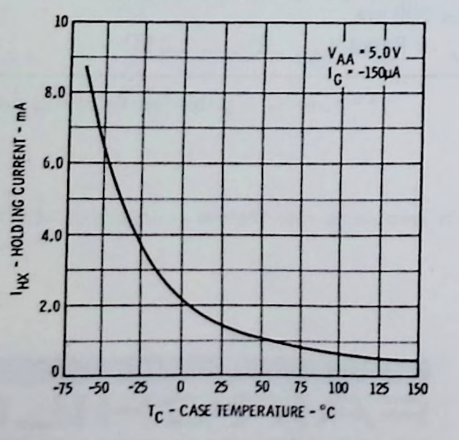
*180° Conduction Angle for Sinusoidal Current Waveform: 50 to 400 Hz.

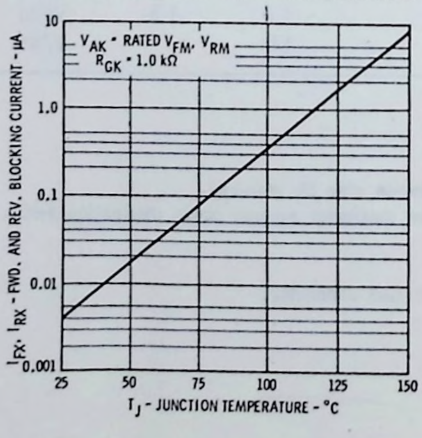
TYPICAL ELECTRICAL CHARACTERISTICS

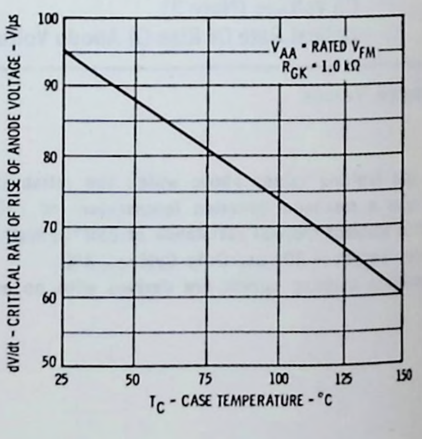

INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT


GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE


GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE


HOLDING CURRENT VERSUS CASE TEMPERATURE


FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE


ALLOWABLE CRITICAL RATE OF RISE OF ANODE VOLTAGE VERSUS CASE TEMPERATURE

For additional information, please fill out and return.

Last Name First Name Middle Initial

Home Address

City State Zip Code

Company Name

Company Address

City State Zip Code

Title

☐ Please send mailing list application.

Please write in information desired, specify quantity and title.

DB69

For additional information, please fill out and return.

Last Name First Name Middle Initial

Home Address

City State Zip Code

Company Name

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Title

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2N884 THROUGH 2N890

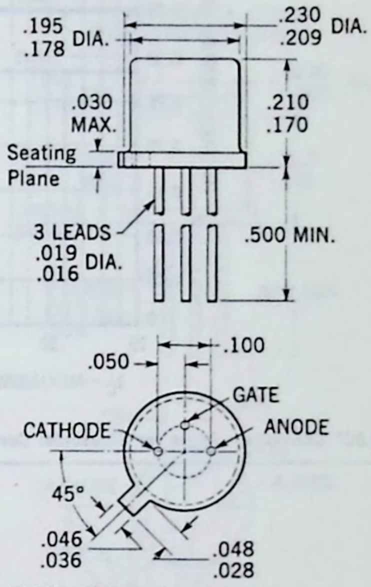
PNPN SILICON CONTROLLED RECTIFIERS

DIFFUSED SILICON PLANAR* THYRISTORS

- **FORWARD CURRENT RATING OF 0.35 AMPS DC AT $T_C = 100°C$**
- **BLOCKING VOLTAGE CAPABILITY TO 300 VOLTS**
- **MAXIMUM GATE TRIGGER CURRENT OF 20 μA AT $T_C = 25°C$**
- **RELIABLE PLANAR CONSTRUCTION**

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Anode internally connected to case
Package weight is 0.43 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures				
†Storage Temperature				−65°C to +150°C
†Operating Temperature				−65°C to +150°C
†Lead Temperature (Soldering, 10 second time limit)				+230°C
Maximum Currents				
RMS Forward Current	$T_C = 100°C$	$I_{F(RMS)}$		430 mA
(180° Conduction Angle) (Note 2)	$T_A = 25°C$			300 mA
Continuous Forward Current	†$T_C = 100°C$	$I_{F(DC)}$		350 mA
(Note 2)	$T_A = 25°C$			240 mA
Average Forward Current	$T_C = 100°C$	$I_{F(AV)}$		280 mA
(180° Conduction Angle) (Note 2)	$T_A = 25°C$			192 mA
†Peak Recurrent Forward Current (Repetition rate 60 pps or higher, ≤ 0.01 duty cycle)	$T_C = 100°C$	I_{FRM}		20 Amps
†Surge Current (Rectangular pulse of 0.2 ms duration, peak)	$T_C = 100°C$	$I_{FM(surge)}$		20 Amps
†Peak Forward Gate Current	$T_C = 100°C$	I_{GFM}		250 mA
Maximum Voltages ($T_C = -65°C$ to $+100°C$)				
†Peak Reverse Gate Voltage		V_{GRM}		5.0 Volts
†DC Forward and Reverse Blocking Voltage		V_{FM}, V_{RM}	2N884	15 Volts
			2N885	30 Volts
			2N886	60 Volts
			2N887	100 Volts
			2N888	150 Volts
			2N889	200 Volts
			2N890	300 Volts

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
†I_{FX}	Forward Blocking Current		0.004	1.0	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$
†I_{FX}(125°C)	Forward Blocking Current		1.5	20	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$
†I_{RX}	Reverse Blocking Current		0.004	1.0	μA	V_{AK} = Rated V_{RM}, $R_{GK} = 1.0\ k\Omega$
†I_{RX}(125°C)	Reverse Blocking Current		1.5	20	μA	V_{AK} = Rated V_{RM}, $R_{GK} = 1.0\ k\Omega$
†I_{GR}	Reverse Gate Current (except 2N890)		0.1	10	μA	$V_{GK} = -2.0\ V$, $I_A = 0$
†I_{GR}	Reverse Gate Current (2N890 only)		0.1	10	μA	$V_{GK} = -5.0\ V$, $I_A = 0$
†I_{GT}	Gate Trigger Current		10	20	μA	$V_{AA} = 5.0\ V$, $R_L = 100\ \Omega$, $R_{GS} = 10\ k\Omega$
†V_{GT}	Gate Trigger Voltage	0.44	0.57	0.60	Volts	$V_{AA} = 5.0\ V$, $R_L = 100\ \Omega$, $R_{GS} = 100\ \Omega$
†I_{HX}	Holding Current	0.1	0.15	1.0	mA	$V_{AA} = 5.0\ V$, $I_G = -50\ \mu A$
†V_F	On Voltage (Note 3)		1.0	1.5	Volts	$I_F = 200$ mA
dV/dt	Critical Rate of Rise of Anode Voltage		95		V/μs	V_{AA} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the reliability of the device may be impaired.

(2) These ratings give a maximum junction temperature of 150°C with the maximum average power dissipation and a maximum junction to case thermal resistance of 44.5°C/Watt and a junction to ambient thermal resistance of 350°C/Watt.

(3) Pulse Conditions: Length = 300 μs; Duty Cycle ≤ 2%.

(4) Ambient temperature derating curves are derived with no external heat sink connected.

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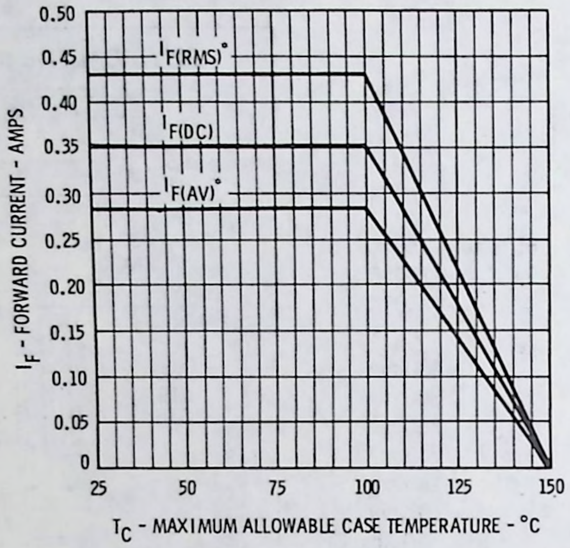
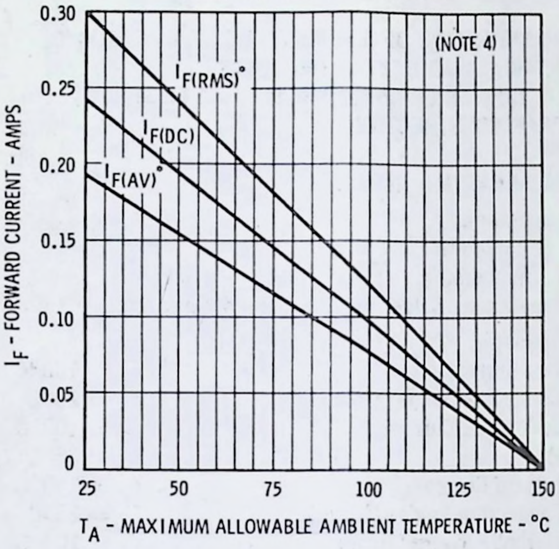
MAXIMUM RATINGS

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE HALF WAVE CONDUCTION°



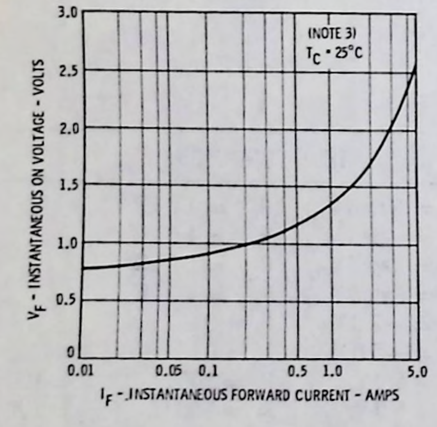
FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE HALF WAVE CONDUCTION°



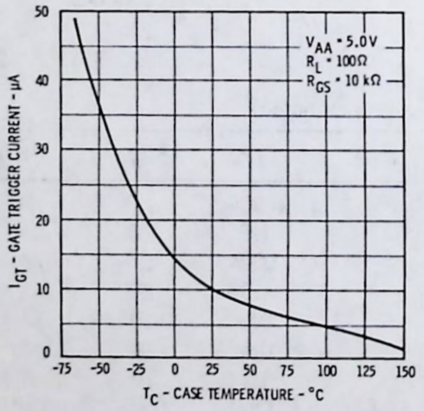
°180° Conduction Angle for Sinusoidal Current Waveform: 50 to 400 Hz.

TYPICAL ELECTRICAL CHARACTERISTICS

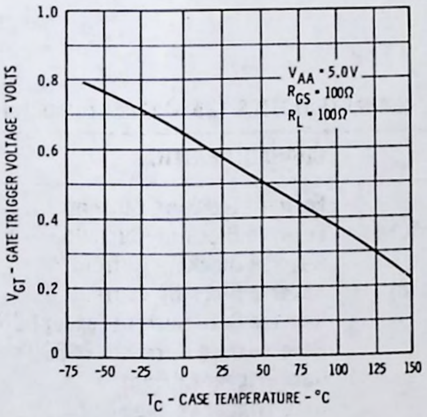
INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT



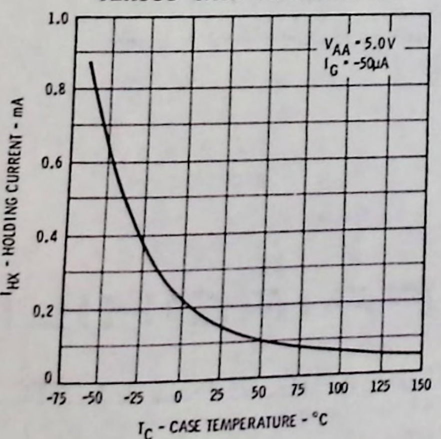
GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE



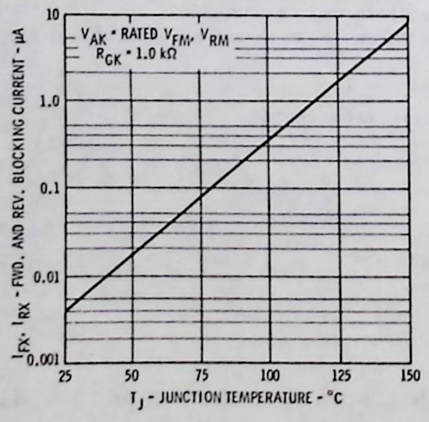
GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE



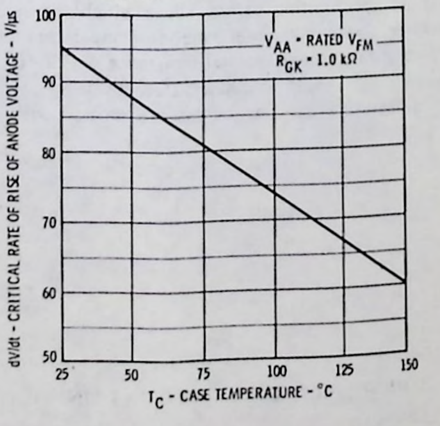
HOLDING CURRENT VERSUS CASE TEMPERATURE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE



ALLOWABLE CRITICAL RATE OF RISE OF ANODE VOLTAGE VERSUS CASE TEMPERATURE



2N892 • 2N894 • 2N896 • 2N898 • 2N900
PNPN SILICON CONTROLLED RECTIFIERS
DIFFUSED SILICON PLANAR* THYRISTORS

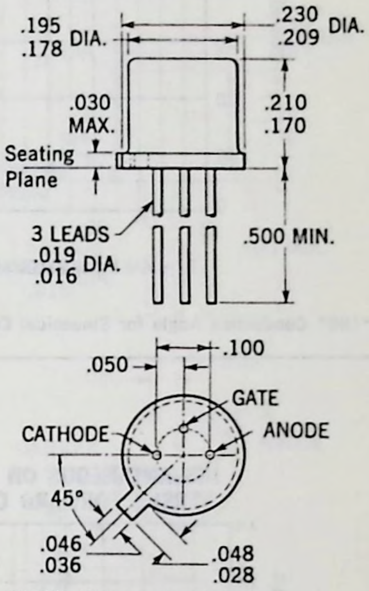
- **CHARACTERIZED FOR TURN-OFF CAPABILITY**
- **FORWARD CURRENT RATING OF 0.3 AMPS AT $T_C = 75°C$**
- **MAXIMUM GATE TRIGGER CURRENT OF 50 μA AT $T_C = 25°C$**
- **RELIABLE PLANAR CONSTRUCTION**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
†Storage Temperature			−65°C to +150°C
†Operating Temperature			−65°C to +125°C
†Lead Temperature (Soldering, 10 second time limit)			+230°C
Maximum Currents			
RMS Forward Current (180° Conduction Angle) (Note 2)	$T_C = 75°C$	$I_{F(RMS)}$	300 mA
	$T_A = 25°C$		188 mA
Continuous Forward Current (Note 2)	†$T_C = 75°C$	$I_{F(DC)}$	250 mA
	$T_A = 25°C$		145 mA
Average Forward Current (180° Conduction Angle) (Note 2)	$T_C = 75°C$	$I_{F(AV)}$	190 mA
	$T_A = 25°C$		120 mA
†Peak Recurrent Forward Current (Repetition rate of 60 pps or higher, ≤ 0.01 duty cycle)	$T_C = 75°C$	I_{FRM}	10 Amps
†Surge Current (Rectangular pulse of 0.2 ms duration, peak)	$T_C = 75°C$	$I_{FM(surge)}$	20 Amps
†Peak Forward Gate Current	$T_C = 75°C$	I_{GFM}	250 mA
Maximum Voltages ($T_C = -65°C$ to $+75°C$)			
†Peak Reverse Gate Voltage		V_{GRM}	5.0 Volts
†DC Reverse Blocking Voltage		V_{RM}	15 Volts
†DC Forward Blocking Voltage	2N892	V_{FM}	15 Volts
	2N894		30 Volts
	2N896		60 Volts
	2N898		100 Volts
	2N900		200 Volts

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Anode internally connected to case
Package weight is 0.43 grams

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
†I_{RX}	Reverse Blocking Current		0.004	10	μA	$V_{AK} = -15\,V$, $R_{GK} = 1.0\,k\Omega$
†I_{FX}	Forward Blocking Current		0.004	10	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\,k\Omega$
†I_{FX}(125°C)	Forward Blocking Current		2.0	100	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\,k\Omega$
†I_{GR}	Reverse Gate Current		0.1	10	μA	$V_{GK} = -5.0\,V$, $I_A = 0$
†I_{GT}	Gate Trigger Current		20	50	μA	$V_{AA} = 5.0\,V$, $R_L = 100\,\Omega$, $R_{GS} = 10\,k\Omega$
†V_{GT}	Gate Trigger Voltage	0.4	0.64	0.7	Volts	$V_{AA} = 5.0\,V$, $R_L = 100\,\Omega$, $R_{GS} = 100\,\Omega$
†I_{GQ}	Gate Turn-Off Current			2.0	mA	$I_F = 4.0$ mA
†V_{GQ}	Gate Turn-Off Voltage			1.5	Volts	$I_F = 4.0$ mA
†V_F	On Voltage (Note 3)		1.05	2.0	Volts	$I_F = 250$ mA
†V_F	On Voltage (Note 3)		0.75	1.0	Volts	$I_F = 4.0$ mA
†t_{gq}	Gate Controlled Turn-Off Time (Note 4)			15	μs	$I_F = 4.0$ mA, $V_{GQ} = 4.0\,V$

JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:
(1) These ratings are limiting values above which the reliability of the device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C with the maximum average power dissipation and a maximum junction to case thermal resistance of 44.5°C/Watt and a junction to ambient thermal resistance of 350°C/Watt.
(3) Pulse Conditions: Length = 300 μs; Duty Cycle ≤ 2%.
(4) Measured in test circuit shown on page 2.
(5) Ambient temperature derating curves are derived with no external heat sink connected.

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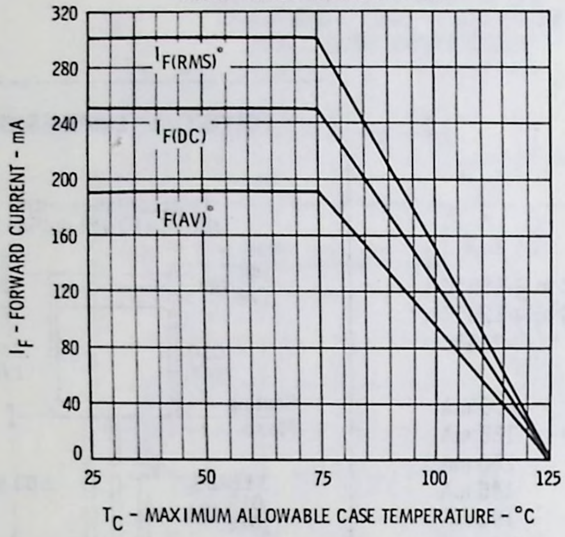
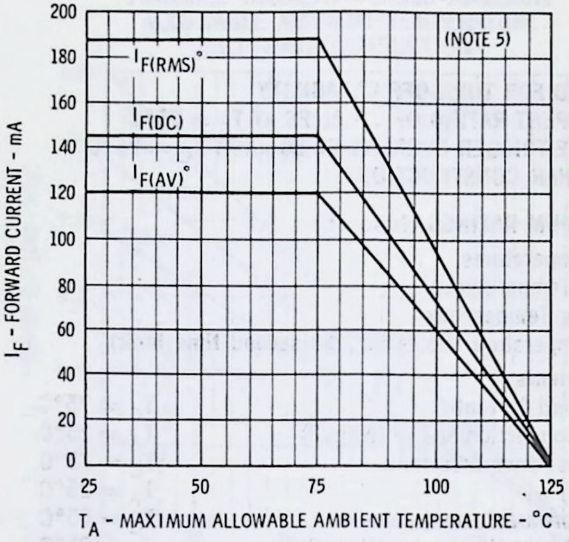
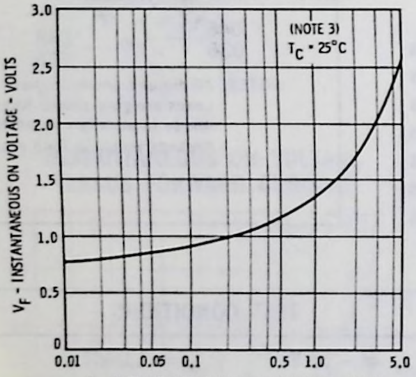
MAXIMUM RATINGS

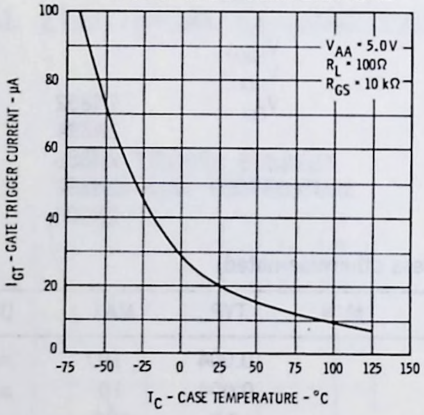

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE HALF WAVE CONDUCTION°

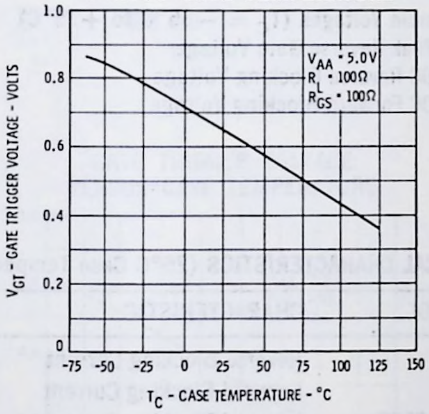

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE HALF WAVE CONDUCTION°

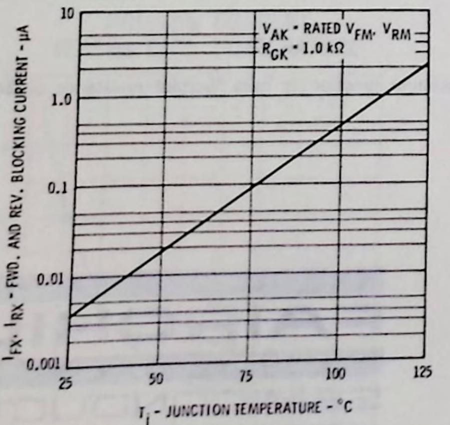
°180° Conduction Angle for Sinusoidal Current Waveform: 50 to 400 Hz.

TYPICAL ELECTRICAL CHARACTERISTICS

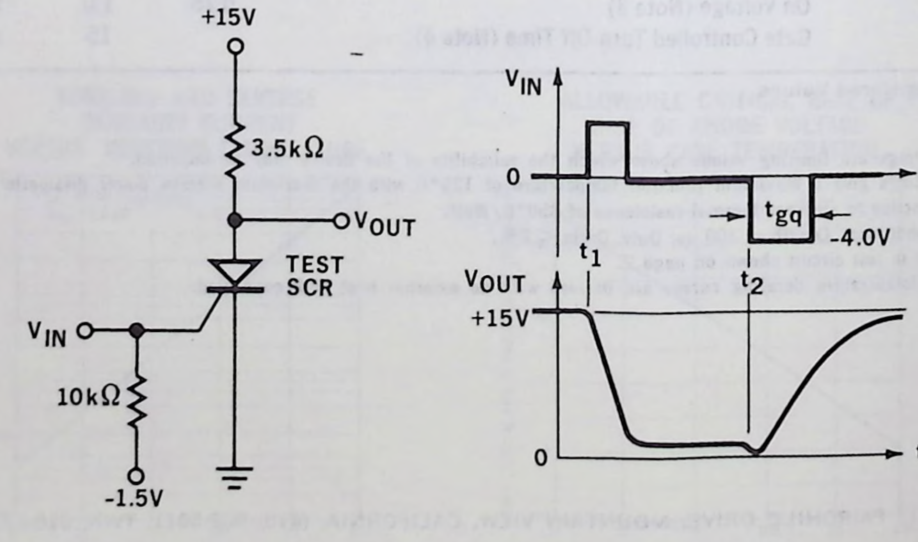

INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT


GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE


GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE


FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE

GATE CONTROLLED TURN-OFF TIME TEST CIRCUIT



Time t_{gq} is the maximum negative pulse duration required to turn-off all devices.

2N948 THROUGH 2N951

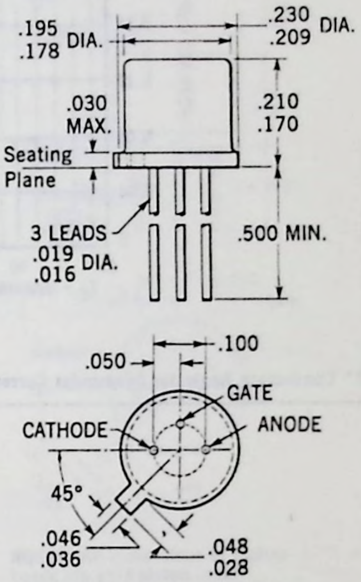
PNPN SILICON CONTROLLED RECTIFIERS

DIFFUSED SILICON PLANAR* THYRISTORS

- **FORWARD CURRENT RATING OF 0.26 AMPS DC AT $T_C = 125°C$**
- **BLOCKING VOLTAGE CAPABILITY TO 200 VOLTS**
- **MAXIMUM GATE TRIGGER CURRENT OF 20 μA AT $T_C = 25°C$**
- **RELIABLE PLANAR CONSTRUCTION**

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Anode internally connected to case
Package weight is 0.43 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature			−65°C to +150°C
†Operating Temperature			−65°C to +150°C
†Lead Temperature (Soldering, 10 second time limit)			+230°C

Maximum Currents and Power

RMS Forward Current	†$T_C = 125°C$	$I_{F(RMS)}$	314 mA
(180° Conduction Angle) (Note 2)	$T_A = 25°C$		236 mA
Continuous Forward Current	†$T_C = 125°C$	$I_{F(DC)}$	260 mA
(Note 2)	$T_A = 25°C$		180 mA
Average Forward Current	†$T_C = 75°C$	$I_{F(AV)}$	200 mA
(180° Conduction Angle) (Note 2)	$T_A = 25°C$		150 mA
†Peak Recurrent Forward Current	$T_C = 110°C$	I_{FRM}	660 mA
†Surge Current (½ cycle sine wave, 60 Hz, peak)	$T_C = 75°C$	$I_{FM(surge)}$	1.0 Amp
†Peak Forward Gate Current	$T_C = 125°C$	I_{GFM}	100 mA
†Peak Gate Power Dissipation	$T_C = 125°C$	P_{GM}	200 mW
†Average Gate Power Dissipation	$T_C = 125°C$	$P_{G(AV)}$	20 mW

Maximum Voltages ($T_C = +25°C$ to $+125°C$)

†Peak Reverse Gate Voltage	V_{GRM}		5.0 Volts
†DC Forward and Reverse Blocking Voltages	V_{FM}, V_{RM}	2N948	30 Volts
		2N949	60 Volts
		2N950	100 Volts
		2N951	200 Volts

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	TYP.	MAX.	UNITS	TEST CONDITIONS	
†I_{FX}	Forward Blocking Current	0.004	1.0	μA	V_{AK} = Rated V_{FM},	$I_G = -20\ \mu$A
†I_{FX}(125°C)	Forward Blocking Current	1.5	20	μA	V_{AK} = Rated V_{FM},	$I_G = -20\ \mu$A
†I_{RO}	Reverse Blocking Current	0.004	1.0	μA	V_{AK} = Rated V_{RM},	$I_G = 0$
†I_{RO}(125°C)	Reverse Blocking Current	1.5	20	μA	V_{AK} = Rated V_{RM},	$I_G = 0$
†I_{GR}	Reverse Gate Current	0.001	10	mA	$V_{GK} = -5.0$ V,	$I_A = 0$
†I_{GT}	Gate Trigger Current	10	20	μA	$V_{AA} = 10$ V,	$R_L = 100\ \Omega$
†V_{GT}	Gate Trigger Voltage	0.59	1.0	Volts	$V_{AA} = 10$ V,	$R_L = 100\ \Omega$
†I_{HO}	Holding Current	0.14	1.0	mA	$R_L = 1.0$ kΩ,	$I_G = 0$
†V_F	On Voltage (Note 3)	1.0	2.0	Volts	$I_F = 200$ mA	
†V_F	On Voltage (Note 3)	0.75	1.2	Volts	$I_F = 10$ mA	
dV/dt	Critical Rate of Rise of Anode Voltage	95		V/μs	V_{AA} = Rated V_{FM},	$R_{GK} = 1.0$ kΩ

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:
(1) These ratings are limiting values above which the reliability of the device may be impaired.
(2) These ratings give a maximum junction temperature of 150°C with the maximum average power dissipation and a maximum junction to case thermal resistance of 44.5°C/Watt and a junction to ambient thermal resistance of 350°C/Watt.
(3) Pulse Conditions: Length = 300 μs; Duty Cycle ≤ 2%.
(4) Ambient temperature derating curves are derived with no external heat sink connected.

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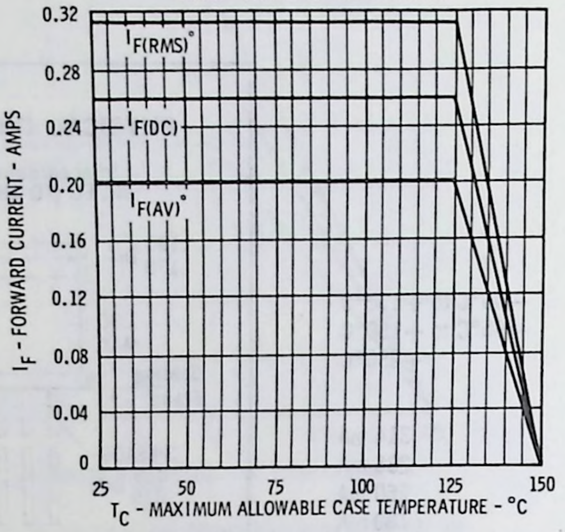
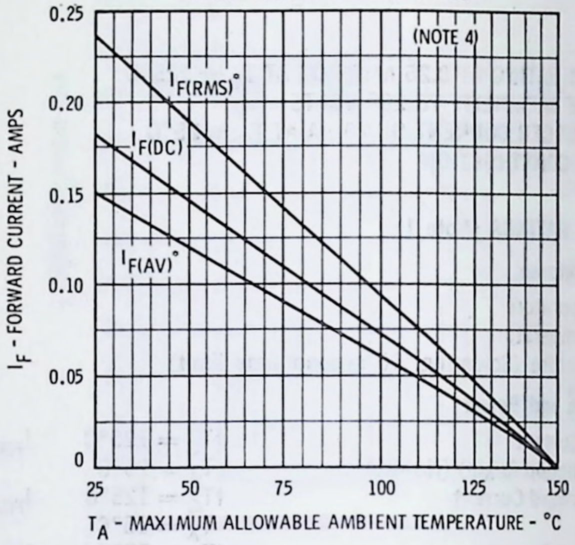
MAXIMUM RATINGS

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE HALF WAVE CONDUCTION*



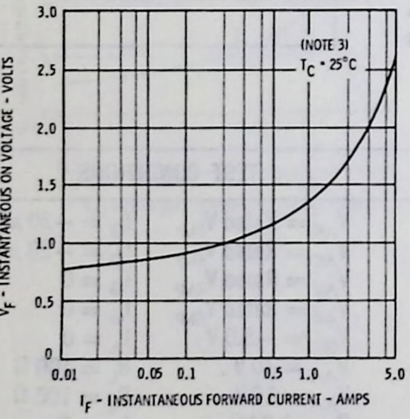
FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE HALF WAVE CONDUCTION*



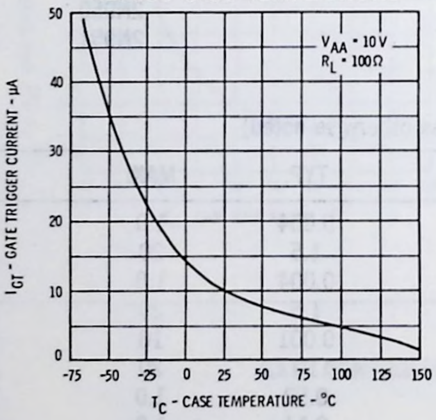
*180° Conduction Angle for Sinusoidal Current Waveform: 50 to 400 Hz.

TYPICAL ELECTRICAL CHARACTERISTICS

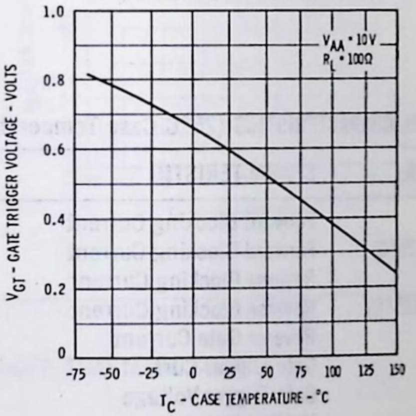
INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT



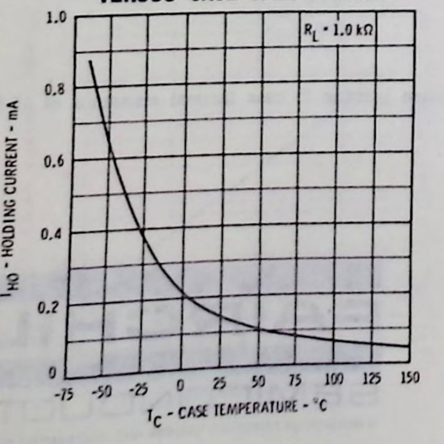
GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE



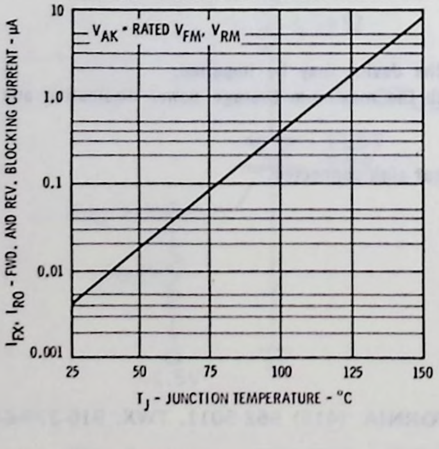
GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE



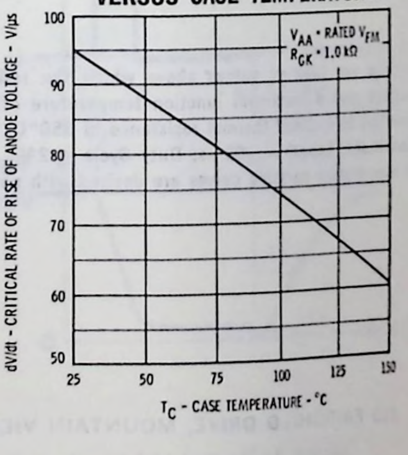
HOLDING CURRENT VERSUS CASE TEMPERATURE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE



ALLOWABLE CRITICAL RATE OF RISE OF ANODE VOLTAGE VERSUS CASE TEMPERATURE



FT1869 THROUGH FT1874

PNPN SILICON CONTROLLED RECTIFIERS

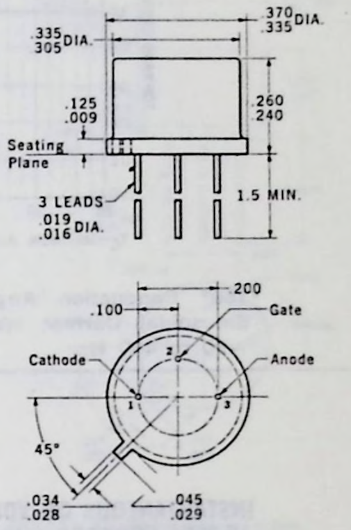
DIFFUSED SILICON PLANAR* THYRISTORS

- FORWARD CURRENT RATING OF 1.25 AMPS DC AT $T_C = 100°C$
- BLOCKING VOLTAGE CAPABILITY TO 200 VOLTS
- MAXIMUM GATE TRIGGER CURRENT OF 200 μA AT $T_C = 25°C$
- IDENTICAL TO 2N1869 THROUGH 2N1874 EXCEPT ANODE CONNECTED TO CASE
- RELIABLE PLANAR CONSTRUCTION

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures				
Storage Temperature		T_{stg}		−65°C to +150°C
Operating Junction Temperature		T_J		−65°C to +150°C
Maximum Currents and Power				
rms Forward Current	$T_C = 100°C$	$I_{F(rms)}$		1.57 Amps
(180° Conduction Angle) (Note 2)	$T_A = 25°C$			590 mA
Continuous Forward Current (Note 2)	$T_C = 100°C$	$I_{F(DC)}$		1.25 Amps
	$T_A = 25°C$			430 mA
Average Forward Current	$T_C = 100°C$	$I_{F(AV)}$		1.0 Amps
(180° Conduction Angle) (Note 2)	$T_A = 25°C$			380 mA
Surge Current	$T_C = 100°C$	$I_{FM(surge)}$		20 Amps
(Rectangular Pulse, Peak, $t_p = 0.2$ ms)				
Peak Forward Gate Current	$T_C = 100°C$	I_{GFM}		0.25 Amps
Maximum Voltages ($T_C = -65°C$ to $+150°C$)				
Peak Reverse Gate Voltage		V_{GRM}		5.0 Volts
Peak Forward and Reverse Blocking Voltages		V_{FM}, V_{RM}	FT1869	15 Volts
			FT1870	30 Volts
			FT1871	60 Volts
			FT1872	100 Volts
			FT1873	150 Volts
			FT1874	200 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Anode internally connected to case
Package weighs 1.23 grams

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otheriwse noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{FX}	Forward Blocking Current		0.02	10	μA	V_{AK} = Rated V_{FM}	$R_{GK} = 1.0\ k\Omega$
$I_{FX}(125°C)$	Forward Blocking Current		6.0	100	μA	V_{AK} = Rated V_{FM}	$R_{GK} = 1.0\ k\Omega$
I_{RX}	Reverse Blocking Current		0.02	10	μA	V_{AK} = Rated V_{RM}	$R_{GK} = 1.0\ k\Omega$
$I_{RX}(125°C)$	Reverse Blocking Current		6.0	100	μA	V_{AK} = Rated V_{RM}	$R_{GK} = 1.0\ k\Omega$
I_{GT}	Gate Trigger Current		40	200	μA	$V_{AA} = 5.0\ V$	$R_L = 100\ \Omega$
V_{GT}	Gate Trigger Voltage	0.4	0.55	0.8	Volts	$V_{AA} = 5.0\ V$	$R_L = 100\ \Omega$
I_{HX}	Holding Current	0.3	0.47	5.0	mA	$V_{AA} = 5.0\ V$	$I_G = -150\ \mu A$
I_{GR}	Reverse Gate Current		0.005	10	μA	$V_{GK} = 2.0\ V$	$I_A = 0$
V_F	On Voltage (Note 4)		1.6	2.5	Volts	$I_F = 2.0\ A$	
dv/dt	Critical Rate of Rise of Anode Voltage		150		V/μs	V_{AA} = Rated V_{FM}	$R_{GK} = 500\ \Omega$

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the reliability of the device may be impaired.
(2) These ratings give a maximum junction temperature of 150°C with the maximum average power dissipation and a junction to case and junction to ambient thermal resistance of 20°C/Watt and 225°C/Watt respectively.
(3) Ambient temperature derating curves are derived with no external heat sink connected.
(4) Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.

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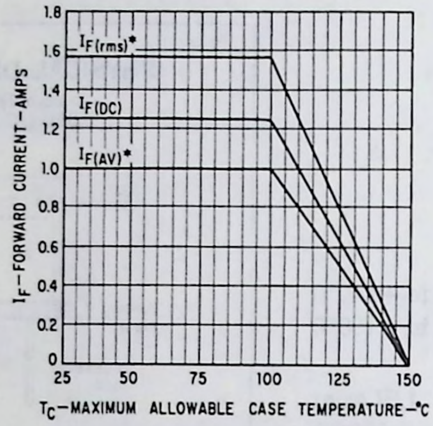
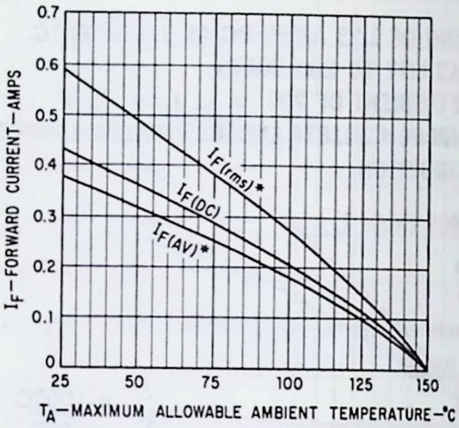
MAXIMUM RATINGS

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE — HALF WAVE CONDUCTION*



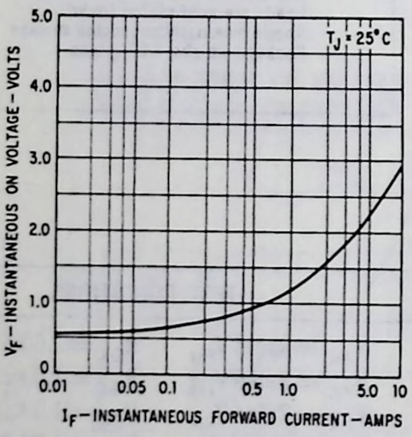
FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE — HALF WAVE CONDUCTION* (Note 3)



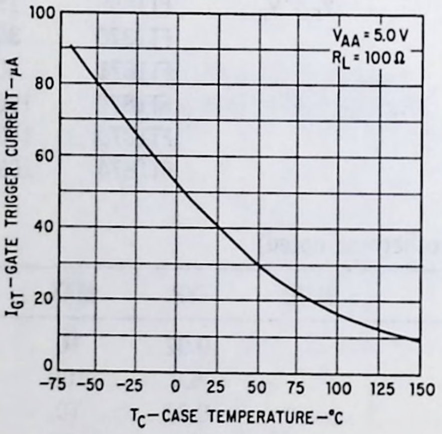
*180° Conduction Angle for Sinusoidal Current Waveform —50 to 400 Hz.

TYPICAL ELECTRICAL CHARACTERISTICS

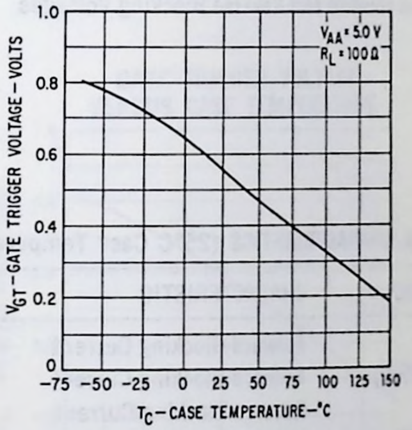
INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT (Note 4)



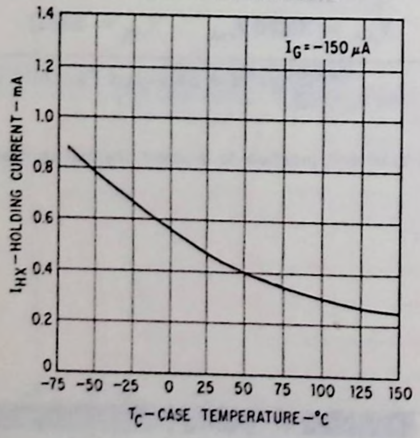
GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE



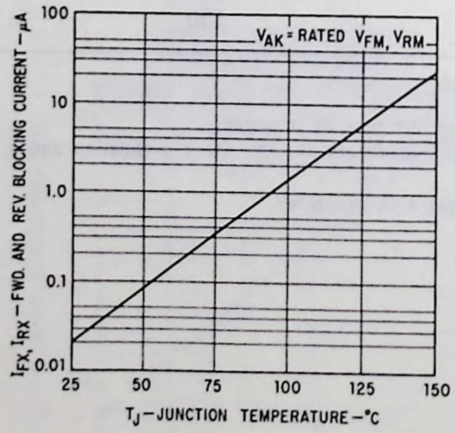
GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE



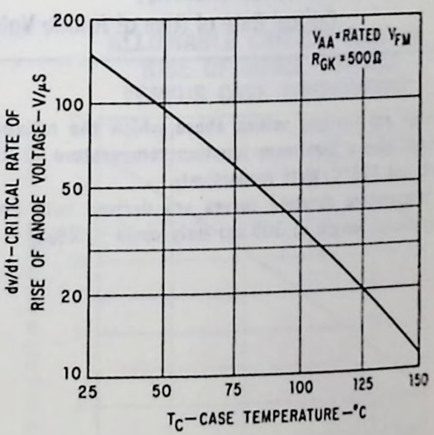
HOLDING CURRENT VERSUS CASE TEMPERATURE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE



ALLOWABLE CRITICAL RATE OF RISE OF ANODE VOLTAGE VERSUS CASE TEMPERATURE



FT1881 THROUGH FT1885

PNPN SILICON CONTROLLED RECTIFIERS

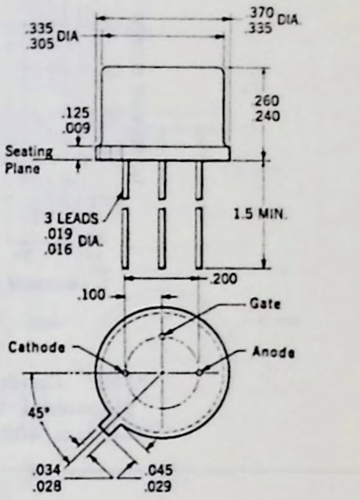
DIFFUSED SILICON PLANAR* THYRISTORS

- FORWARD CURRENT RATING OF 1.25 AMPS DC AT $T_C = 100°C$
- BLOCKING VOLTAGE CAPABILITY TO 200 VOLTS
- MAXIMUM GATE TRIGGER CURRENT OF 2.0 mA AT 25°C
- IDENTICAL TO 2N1881 THRU 2N1885 EXCEPT ANODE CONNECTED TO CASE
- RELIABLE PLANAR* CONSTRUCTION

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures				
Storage Temperature		T_{stg}		−65°C to +150°C
Operating Junction Temperature		T_J		−65°C to +150°C
Maximum Currents and Power				
rms Forward Current (180° conduction angle)(Note 2)	$T_C = 100°C$	$I_{F(rms)}$		1.57 Amps
	$T_A = 25°C$			590 mA
Continuous Forward Current	$T_C = 100°C$	$I_{F(DC)}$		1.25 Amps
	$T_A = 25°C$			430 mA
Average Forward Current (180° conduction angle)(Note 2)	$T_C = 100°C$	$I_{F(AV)}$		1.0 Amps
	$T_A = 25°C$			380 mA
Surge Current (Rectangular Pulse, Peak, $t_p = 0.2$ ms)	$T_C = 100°C$	$I_{FM(surge)}$		20 Amps
Peak Forward Gate Current	$T_C = 100°C$	I_{GFM}		0.25 Amps
Maximum Voltages				
Peak Reverse Gate Voltage	$T_C = 100°C$	V_{GRM}		5.0 Volts
Peak Forward and Reverse Blocking Voltages	$T_C = 100°C$	V_{FM}, V_{RM}	FT1881	30 Volts
			FT1882	60 Volts
			FT1883	100 Volts
			FT1884	150 Volts
			FT1885	200 Volts

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated Kovar
Anode internally connected to case
Package weight is 1.23 grams

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
I_{FX}	Forward Blocking Current		0.02	10	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$
I_{FX}(125°C)	Forward Blocking Current		6	200	μA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$
I_{RX}	Reverse Blocking Current		0.02	10	μA	V_{AK} = Rated V_{RM}, $R_{GK} = 1.0\ k\Omega$
I_{RX}(125°C)	Reverse Blocking Current		6	200	μA	V_{AK} = Rated V_{RM}, $R_{GK} = 1.0\ k\Omega$
I_{GT}	Gate Trigger Current		0.04	2.0	mA	$V_{AA} = 5.0\ V$, $R_L = 100\ \Omega$
V_{GT}	Gate Trigger Voltage	0.4	0.55	2.0	Volts	$V_{AA} = 5.0\ V$, $R_L = 100\ \Omega$
I_{HO}	Holding Current		0.23	2.0	mA	$R_{GK} = \infty$, $R_L = 100\ \Omega$
I_{GR}	Reverse Gate Current		0.005	1.0	μA	$V_{GK} = -5.0\ V$, $I_A = 0$
I_{GR}(125°C)	Reverse Gate Current		0.005		mA	$V_{GK} = -5.0\ V$, $I_A = 0$
V_F	On Voltage (Note 4)		1.2	2.0	Volts	$I_F = 1.0$ Amps
dV/dt	Critical Rate of Rise of Anode Voltage		150		V/μs	V_{AA} = Rated V_{FM}, $R_{GK} = 500\ \Omega$

*Planar is a patented Fairchild process.

NOTES:

These ratings are limiting values above which the reliability of the device may be impaired.
These ratings give a maximum junction temperature of 150°C with the maximum average power dissipation and a maximum junction to case thermal resistance of 20°C/Watt and a junction to ambient thermal resistance of 225°C/Watt.
Ambient temperature derating curves are derived with no external heat sink connected.
Pulse Conditions: Length = 300 μs; Duty Cycle ≤ 2%.

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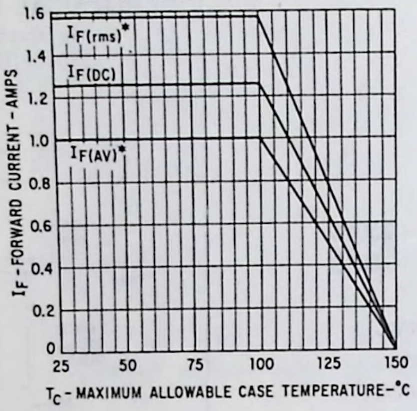
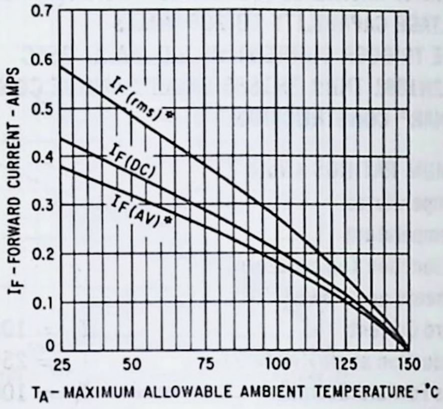
FAIRCHILD THYRISTORS FT1881 THROUGH FT1885

MAXIMUM RATINGS

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE HALF WAVE CONDUCTION*



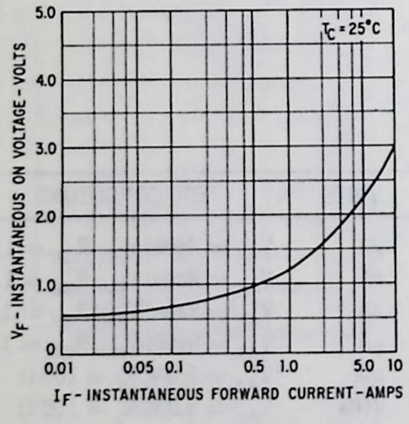
FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE HALF WAVE CONDUCTION*
(Note 3)



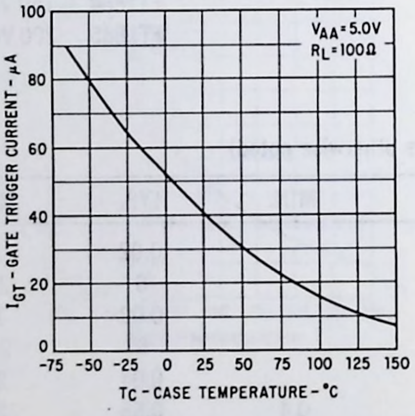
*180° Conduction Angle for Sinusoidal Current Waveform —50 to 400 Hz.

TYPICAL ELECTRICAL CHARACTERISTICS

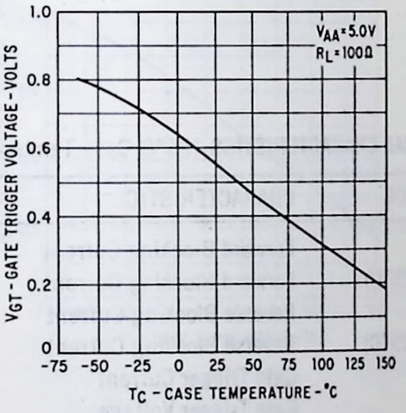
INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT
(Note 4)



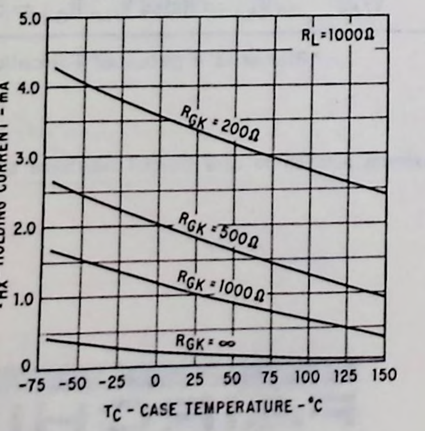
GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE



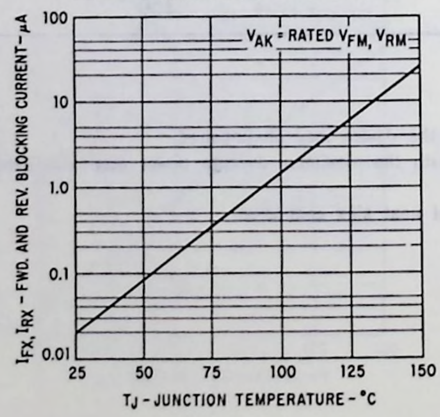
GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE



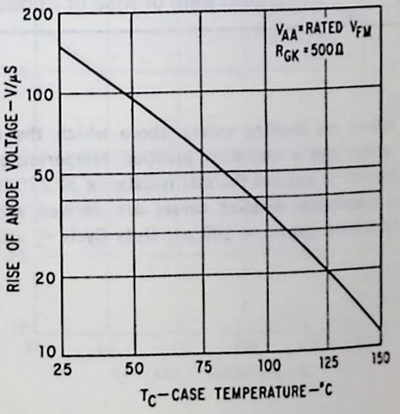
HOLDING CURRENT VERSUS CASE TEMPERATURE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE



ALLOWABLE CRITICAL RATE OF RISE OF ANODE VOLTAGE VERSUS CASE TEMPERATURE



FT2009 THROUGH FT2014

PNPN SILICON CONTROLLED RECTIFIERS

DIFFUSED SILICON PLANAR* THYRISTORS

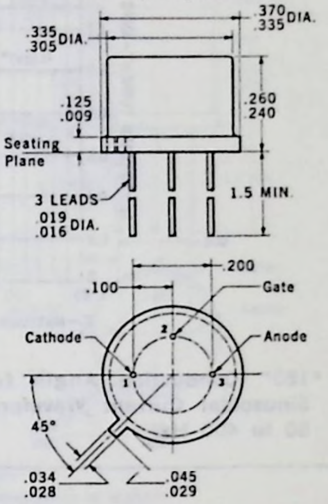
- **FORWARD CURRENT RATING OF 1.3 AMPS DC AT $T_C = 80°C$**
- **BLOCKING VOLTAGE CAPABILITY TO 400 VOLTS**
- **MAXIMUM GATE TRIGGER CURRENT OF 200 μA AT $T_C = 25°C$**
- **IDENTICAL TO 2N2009 THROUGH 2N2014 EXCEPT ANODE CONNECTED TO CASE**
- **RELIABLE PLANAR CONSTRUCTION**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
Storage Temperature		T_{stg}	−65°C to +150°C
Operating Junction Temperature		T_J	−65°C to +150°C
Maximum Currents and Power			
rms Forward Current	$T_C = 80°C$	$I_{F(rms)}$	1.57 Amps
(180° conduction angle, note 2)	$T_A = 25°C$		590 mA
Continuous Forward Current	$T_C = 80°C$	$I_{F(DC)}$	1.3 Amps
	$T_A = 25°C$		430 mA
Average Forward Current	$T_C = 80°C$	$I_{F(AV)}$	1.0 Amps
(180° conduction angle, note 2)	$T_A = 25°C$		375 mA
Surge Current			
(½ cycle sine wave, 60 Hz, peak)	$T_C = 80°C$	$I_{FM(surge)}$	15 Amps
Peak Forward Gate Current			
(pulse width = 8 ms)	$T_C = 125°C$	I_{GFM}	1.3 Amps
Peak Gate Power Dissipation		P_{GM}	0.2 Watt
Average Gate Power Dissipation		$P_{G(AV)}$	0.05 Watt
Maximum Voltages ($T_C = +25°C$ to $+80°C$)			
Peak Reverse Gate Voltage		V_{GRM}	6.0 Volts
Peak Forward and Reverse		V_{FM}, V_{RM} FT2009	25 Volts
Blocking Voltages		FT2010	50 Volts
		FT2011	100 Volts
		FT2012	200 Volts
		FT2013	300 Volts
		FT2014	400 Volts

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-5) outline



NOTES:

All dimensions in inches
Leads are gold-plated Kovar
Anode internally connected to case
Package weight is 1.23 grams

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	TYP.	MAX.	UNITS	TEST CONDITIONS
I_{FX}	Forward Blocking Current	20	100	nA	V_{AK} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$
I_{FX}(125°C)	Forward Blocking Current	6.0	100	μA	V_{AK} = Rated V_{FM}, $V_{GK} = -0.5$ V
I_{RO}	Reverse Blocking Current	20	100	nA	V_{AK} = Rated V_{RM}, $R_{GK} = \infty$
I_{RO}(125°C)	Reverse Blocking Current	6.0	100	μA	V_{AK} = Rated V_{RM}, $R_{GK} = \infty$
I_{GT}	Gate Trigger Current	40	200	μA	$V_{AA} = 5.0$ V, $R_L = 1.0\ k\Omega$
V_{GT}	Gate Trigger Voltage	0.55	1.0	Volts	$V_{AA} = 12$ V, $R_L = 1.0\ k\Omega$
I_{HO}	Holding Current	0.25	2.0	mA	$R_{GK} = \infty$, $R_L = 1.0\ k\Omega$
I_{HO}(80°C)	Holding Current	0.16	5.0	mA	$R_{GK} = \infty$, $R_L = 1.0\ k\Omega$
I_{GR}	Reverse Gate Current	0.005	1.0	μA	$V_{GK} = -6.0$ V, $I_A = 0$
I_{GR}(125°C)	Reverse Gate Current	0.005	1.0	mA	$V_{GK} = -6.0$ V, $I_A = 0$
V_F	On Voltage (Note 4)	1.2	2.0	Volts	$I_F = 1.0$ A
dV/dt	Critical Rate of Rise of Anode Voltage	150		V/μs	V_{AA} = Rated V_{FM}, $R_{GK} = 500\ \Omega$

*Planar is a patented Fairchild process.

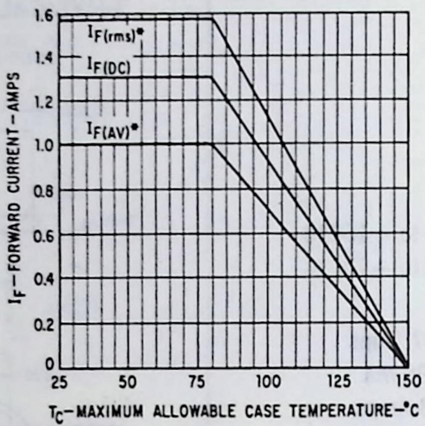
NOTES:

(1) These ratings are limiting values above which the reliability of the device may be impaired.
(2) These ratings give a maximum junction temperature of 150°C with the maximum average power dissipation and a maximum junction to case thermal resistance of 35°C/Watt and a junction to ambient thermal resistance of 225°C/Watt.
(3) Ambient temperature derating curves are derived with no external heat sink connected.
(4) Pulse Conditions: Length = 300 μs; Duty Cycle ≤ 2%.

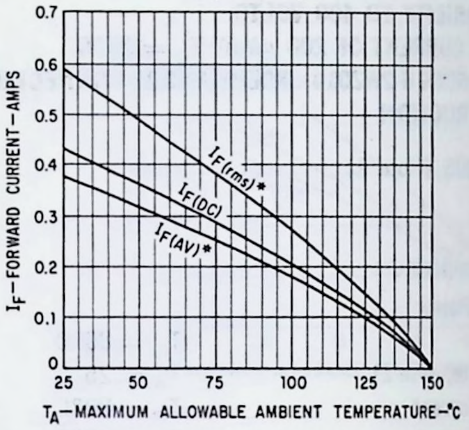
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

MAXIMUM RATINGS

FORWARD CURRENT
VERSUS MAXIMUM ALLOWABLE
CASE TEMPERATURE
HALF WAVE CONDUCTION*



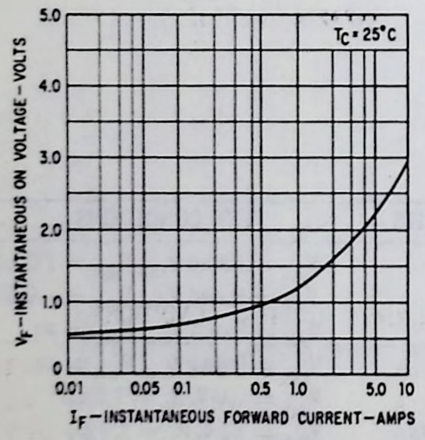
FORWARD CURRENT
VERSUS MAXIMUM ALLOWABLE
AMBIENT TEMPERATURE
HALF WAVE CONDUCTION*
(Note 3)



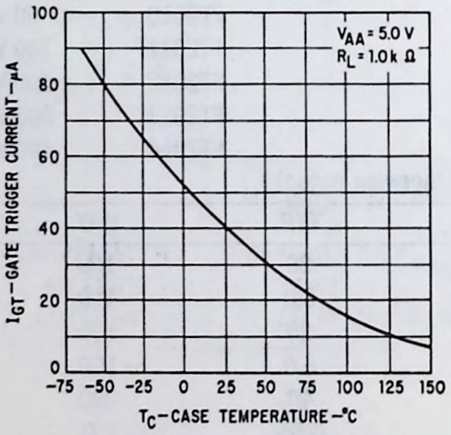
*180° Conduction Angle for Sinusoidal Current Waveform 50 to 400 Hz.

TYPICAL ELECTRICAL CHARACTERISTICS

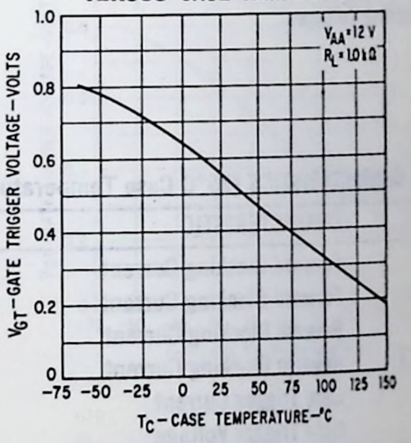
INSTANTANEOUS ON VOLTAGE
VERSUS FORWARD CURRENT
(Note 4)



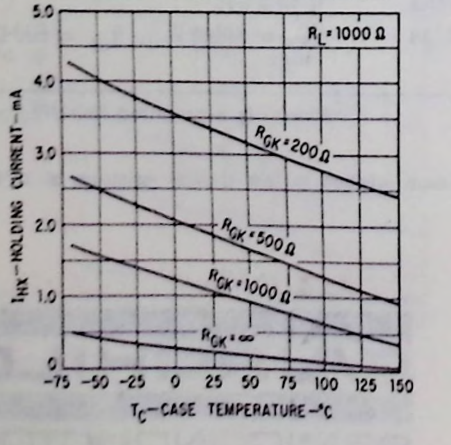
GATE TRIGGER CURRENT
VERSUS CASE TEMPERATURE



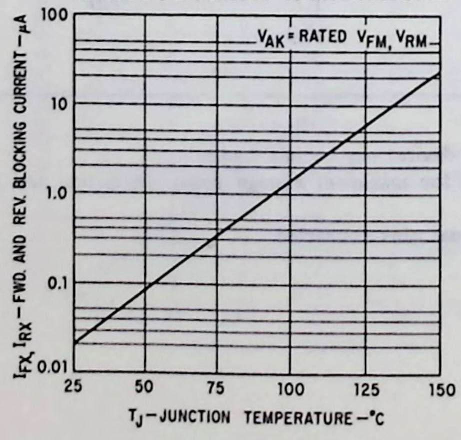
GATE TRIGGER VOLTAGE
VERSUS CASE TEMPERATURE



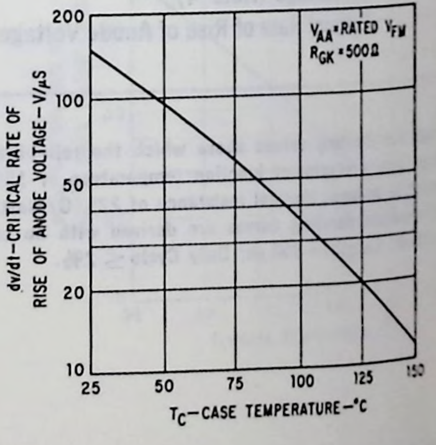
HOLDING CURRENT
VERSUS CASE TEMPERATURE



FORWARD AND REVERSE
BLOCKING CURRENT
VERSUS JUNCTION TEMPERATURE



ALLOWABLE CRITICAL RATE OF
RISE OF ANODE VOLTAGE
VERSUS CASE TEMPERATURE

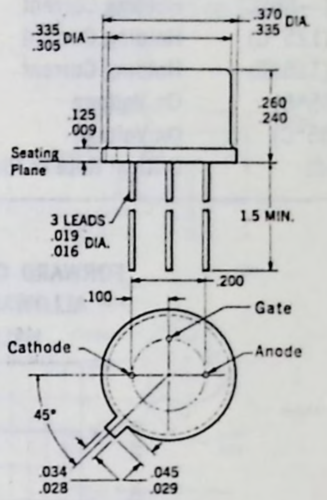


2N2322 THROUGH 2N2329
2N2322A THROUGH 2N2329A
PNPN SILICON CONTROLLED RECTIFIERS
DIFFUSED SILICON PLANAR* THYRISTORS

- **FORWARD CURRENT RATING OF 1.6 AMP DC AT $T_C = 85°C$**
- **BLOCKING VOLTAGE CAPABILITY TO 400 VOLTS**
- **MAXIMUM GATE TRIGGER CURRENT OF 100 μA FOR 2N2322 SERIES AND 25 μA FOR 2N2322A SERIES AT $T_C = 25°C$**
- **RELIABLE PLANAR CONSTRUCTION**

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-5) outline



NOTES:

All dimensions in inches.
Leads are gold plated kovar.
Anode internally connected to case.
Package weight is 1.23 grams.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
†Storage Temperature		T_{stg}	−65°C to +150°C
†Operating Junction Temperature		T_J	−65°C to +125°C
† Lead Temperature (Soldering, 10 second time limit)			+230°C
Maximum Currents and Power			
rms Forward Current	$T_C = 85°C$	$I_{F(rms)}$	2.0 Amps
(180° Conduction Angle)	$T_C = 25°C$		490 mA
Continuous Forward Current	†$T_C = 85°C$	$I_{F(DC)}$	1.6 Amps
	$T_A = 25°C$		355 mA
Average Forward Current	†$T_C = 85°C$	$I_{F(AV)}$	1.0 Amp
(180° Conduction Angle)	$T_A = 25°C$		310 mA
†Surge Current	$T_C = 85°C$	$I_{FM(surge)}$	15 Amps
(½ cycle, sine wave, 60 Hz, Peak)			
†Peak Forward Gate Current	$T_C = 85°C$	I_{GFM}	100 mA
†Peak Gate Power Dissipation	$T_C = 85°C$	P_{GM}	0.1 Watt
†Average Gate Power Dissipation	$T_C = 85°C$	$P_{G(AV)}$	0.01 Watt

Maximum Voltages, ($T_C = -65°C$ TO $+125°C$)

†Peak Reverse Gate Voltage V_{GRM} 6.0 Volts

		2N2322 2N2322A	2N2323 2N2323A	2N2324 2N2324A	2N2325 2N2325A	2N2326 2N2326A	2N2327 2N2327A	2N2328 2N2328A	2N2329 2N2329A	
†Peak Forward and Reverse Blocking Voltages	V_{FM}, V_{RM}	25	50	100	150	200	250	300	400	Volts
†Transient Peak Reverse Blocking Voltage (5 ms Max.)	V_{RSM}	40	75	150	225	300	350	400	500	Volts

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N2322 through 2N2329		2N2322A through 2N2329A				
SYMBOL	CHARACTERISTIC	TYP.	MAX.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{FX}	Forward Blocking Current	20		20		nA	V_{AK} = Rated V_{FM}	$R_{GK} = 1\,k\Omega$
†$I_{FX}(125°C)$	Forward Blocking Current	10	100			μA	V_{AK} = Rated V_{FM}	$R_{GK} = 1\,k\Omega$
†$I_{FX}(125°C)$	Forward Blocking Current			10	100	μA	V_{AK} = Rated V_{FM}	$R_{GK} = 2\,k\Omega$
I_{RX}	Reverse Blocking Current	20		20		nA	V_{AK} = Rated V_{RM}	$R_{GK} = 1\,k\Omega$
†$I_{RX}(125°C)$	Reverse Blocking Current	10	100			μA	V_{AK} = Rated V_{RM}	$R_{GK} = 1\,k\Omega$
†$I_{RX}(125°C)$	Reverse Blocking Current			10	100	μA	V_{AK} = Rated V_{RM}	$R_{GK} = 2\,k\Omega$
I_{GT}	Gate Trigger Current	40	100	12	25	μA	$V_{AA} = 6.0\,V$	$R_L = 100\,\Omega$
†$I_{GT}(-65°C)$	Gate Trigger Current	120	350	36	75	μA	$V_{AA} = 6.0\,V$	$R_L = 100\,\Omega$

†JEDEC Registered Values

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the reliability of the device may be impaired.
(2) Ambient temperature derating curves are derived with no external heat sink connected.
(3) Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

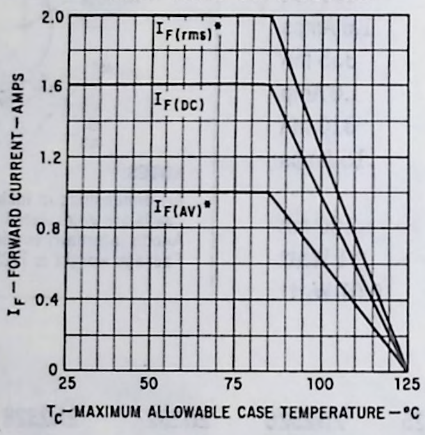
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

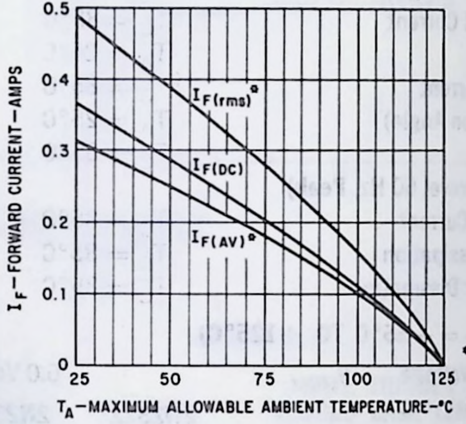
SYMBOL	CHARACTERISTICS	2N2322 through 2N2329 MIN.	TYP.	MAX.	2N2322A through 2N2329A MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
V_{GT}	Gate Trigger Voltage		0.55			0.55		Volts	$V_{AA} = 6.0\,V$	$R_L = 100\,\Omega$
†$V_{GT}(-65°C)$	Gate Trigger Voltage		0.81	1.0		0.81	0.9	Volts	$V_{AA} = 6.0\,V$	$R_L = 100\,\Omega$
†$V_{GT}(125°C)$	Gate Trigger Voltage	0.1	0.2		0.1	0.2		Volts	$V_{AA} = \text{Rated } V_{FM}$	$R_L = 100\,\Omega$
I_{HX}	Holding Current		0.9					mA	$R_{GK} = 1\,k\Omega$	$R_L = 10\,k\Omega$
I_{HX}	Holding Current					0.4		mA	$R_{GK} = 2\,k\Omega$	$R_L = 10\,k\Omega$
†$I_{HX}(-65°C)$	Holding Current		1.75	3.0				mA	$R_{GK} = 1\,k\Omega$	$R_L = 10\,k\Omega$
†$I_{HX}(-65°C)$	Holding Current					0.7	3.0	mA	$R_{GK} = 2\,k\Omega$	$R_L = 10\,k\Omega$
†$I_{HX}(125°C)$	Holding Current	0.15	0.2					mA	$R_{GK} = 1\,k\Omega$	$R_L = 50\,k\Omega$
†$I_{HX}(125°C)$	Holding Current				0.10	0.15		mA	$R_{GK} = 2\,k\Omega$	$R_L = 50\,k\Omega$
†$V_F(85°C)$	On Voltage		1.7	2.0		1.7	2.0	Volts	$I_F = 3.14\,A$	
†$V_F(85°C)$	On Voltage		1.3	1.5		1.3	1.5	Volts	$I_F = 1.6\,A$	
dV/dt	Critical Rate of Rise of Anode Voltage		150			150		V/μs	$V_{AA} = \text{Rated } V_{FM}$	$R_{GK} = 500\,\Omega$

MAXIMUM RATINGS

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE HALF WAVE CONDUCTION*



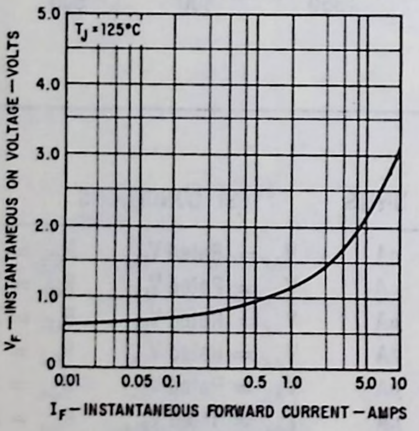
FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE HALF WAVE CONDUCTION* (Note 2)



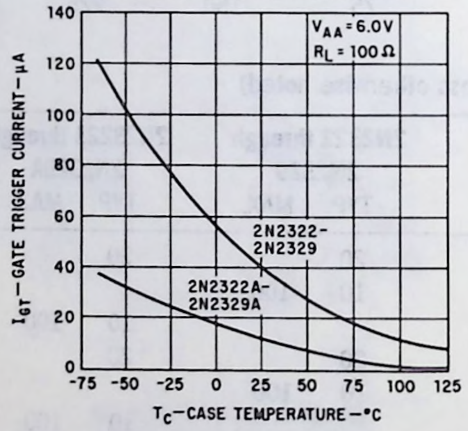
*180° Conduction Angle for Sinusoidal Current Waveform; 50 to 400 Hz

TYPICAL ELECTRICAL CHARACTERISTICS

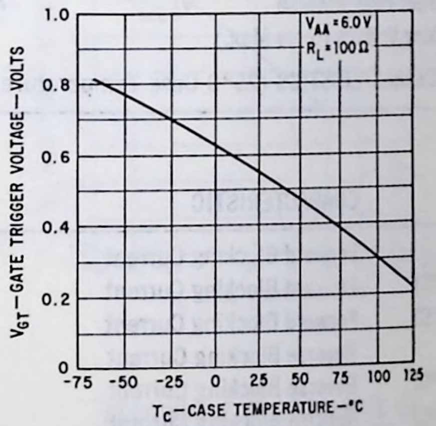
INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT (Note 3)



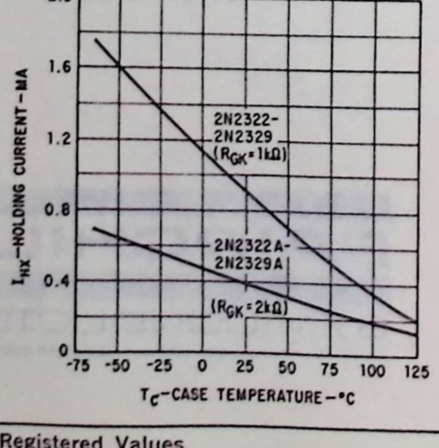
GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE



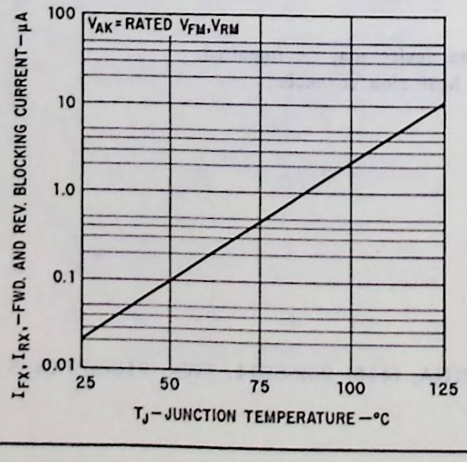
GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE



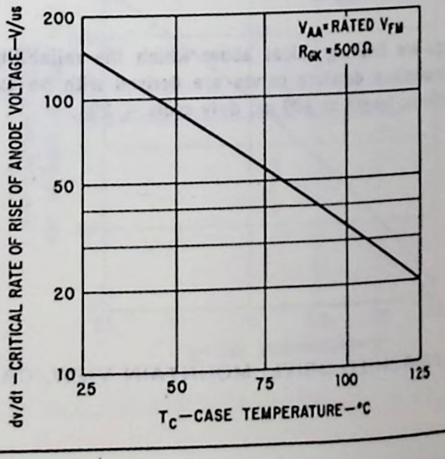
HOLDING CURRENT VERSUS CASE TEMPERATURE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE



ALLOWABLE CRITICAL RATE OF RISE OF ANODE VOLTAGE VERSUS CASE TEMPERATURE

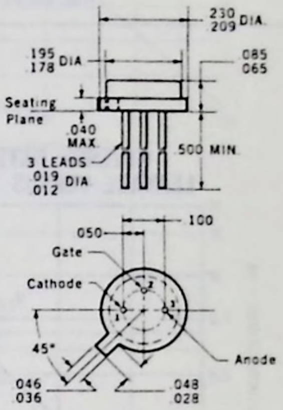


†JEDEC Registered Values

2N4096 • 2N4097 • 2N4098
PNPN SILICON CONTROLLED RECTIFIERS
DIFFUSED SILICON PLANAR DEVICES

- **OPERATION TO 125°C GUARANTEED WITH NO FORWARD OR REVERSE VOLTAGE DERATING.**
- **LOW FORWARD "ON" VOLTAGE GUARANTEED AT 3 POINTS.**
- **LOW FORWARD AND REVERSE LEAKAGES GUARANTEED.**
- **PLANAR RELIABILITY BUILT IN.**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	− 65°C to + 125°C
Operating Junction Temperature	− 65°C to + 125°C
Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C Maximum

Maximum Power Dissipation

Average Gate Power Dissipation at 25°C Ambient Temperature (Note 2)	**0.1 Watt**

Maximum Currents

DC Forward Current at 25°C Case Temperature (Note 2)	1.0 Amp.
DC Forward Current at 25°C Ambient Temperature	175 mA
Surge Current at 25°C Ambient Temperature (Note 2) (½ cycle sine wave = 8.3 msec)	**4.0 Amps.**
Average Forward Current at 25°C Ambient Temperature 180° Conduction	130 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise specified)

SYMBOL	CHARACTERISTICS		MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{FX}	Forward Blocking Voltage **(T_A = − 65°C to + 125°C)**	2N4096	50			Volts	I_{FX} = **0.05** μA, R_{GK} = 1.0 K
		2N4097	100			Volts	
		2N4098	200			Volts	
V_{RO}	Reverse Blocking Voltage **(T_A = − 65°C to + 125°C)**	2N4096	50			Volts	I_{RO} = **0.05** μA, R_{GK} = ∞
		2N4097	100			Volts	
		2N4098	200			Volts	
I_{FX}	Forward Blocking Current (at rated V_{FX})			8	50	nA	R_{GK} = 1.0 KΩ
I_{FX} (125°C)	Forward Blocking Current (at rated V_{FX})			5	20	μA	R_{GK} = 1.0 KΩ
I_{RO}	Reverse Blocking Current (at rated V_{RO})			8	50	nA	R_{GK} = ∞
I_{RO} (125°C)	Reverse Blocking Current (at rated V_{RO})			5	20	μA	R_{GK} = ∞
I_{GT}	Gate Trigger Current			0.060	**0.2**	mA	V_{AK} = 10V, R_L = 100Ω
I_{GT} (−55°C)	Gate Trigger Current			0.110	2.0	mA	V_{AK} = 10V, R_L = 100Ω
V_{GT}	Gate Trigger Voltage			0.58	0.8	Volts	V_{AK} = 10V, R_L = 100Ω
V_{GT} (−55°C)	Gate Trigger Voltage			0.75	1.1	Volts	V_{AK} = 10V, R_L = 100Ω
V_{GT} (125°C)	Gate Trigger Voltage **(at rated V_{FX})**		0.2	0.4		Volts	R_L = 10 KΩ

Additional Electrical Characteristics on page 2

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 44.5°C/Watt (derating factor of 22.5 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).

FAIRCHILD
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A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

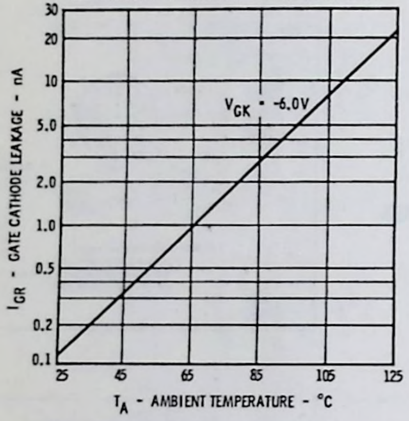
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise specified)

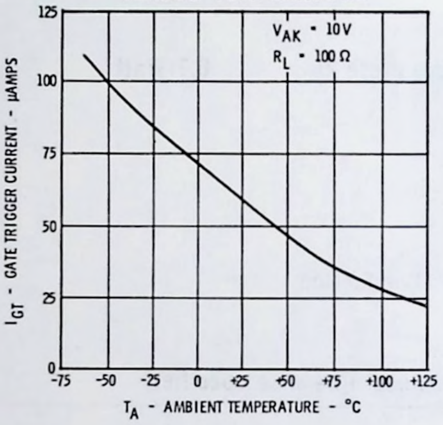
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	On Voltage		0.95	1.15	Volts	$I_F = 175$ mA
V_F	On Voltage		1.05	**1.2**	Volts	$I_F = 250$ mA
V_F	On Voltage		1.2	**1.6**	Volts	$I_F = 500$ mA
I_{HO}	Holding Current		0.7	2.0	mA	$R_G = \infty$, $R_L = 1.0\,K\Omega$
I_{GR}	Gate Leakage Current		0.13	25	nA	$I_F = 0$, $V_{GK} = -6.0\,V$
I_{GR} (125°C)	Gate Leakage Current		0.024	10	μA	$I_F = 0$, $V_{GK} = -6.0\,V$
t_{on}	Turn On Time		0.56	**1.5**	μsec	$I_F \approx 200$ mA, $I_{GF} = 10$ mA
t_{off}	Turn Off Time (see t_{off} circuit)		6.5	**15**	μsec	$I_F = I_R \approx 200$ mA
dv/dt	Critical Rate of Rise (at rated V_{FX})	75	200		Volts/μsec	$R_{GK} = 1\,K\Omega$, $R_L = 100\,\Omega$

GATE CHARACTERISTICS

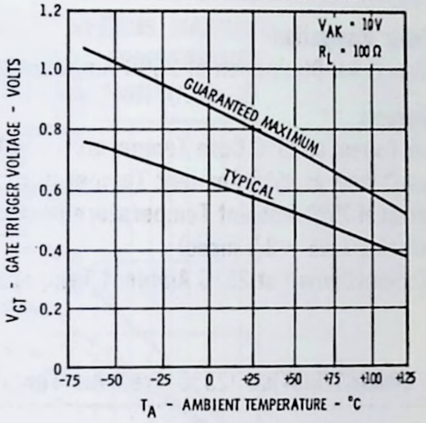
REVERSE GATE-CATHODE LEAKAGE VERSUS TEMPERATURE



GATE TRIGGER CURRENT VERSUS TEMPERATURE

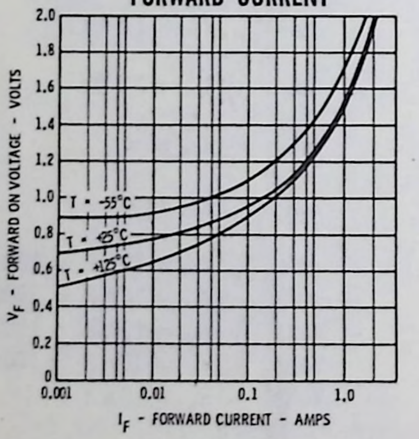


GATE TRIGGER VOLTAGE VERSUS TEMPERATURE

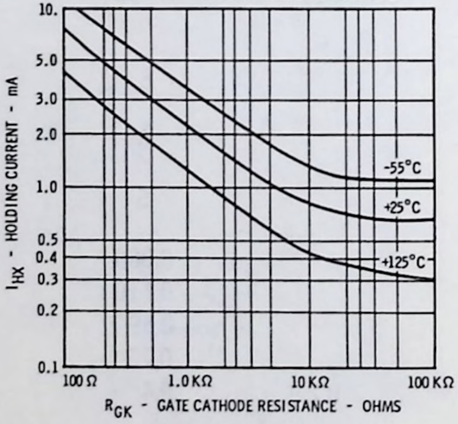


TYPICAL ELECTRICAL CHARACTERISTICS

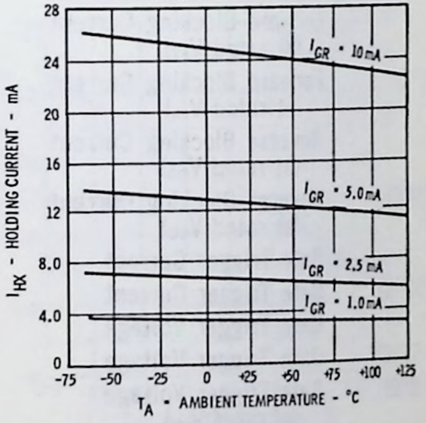
ON VOLTAGE VERSUS FORWARD CURRENT



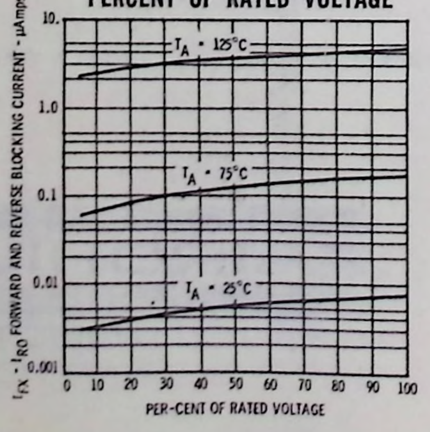
HOLDING CURRENT VERSUS GATE-CATHODE RESISTANCE



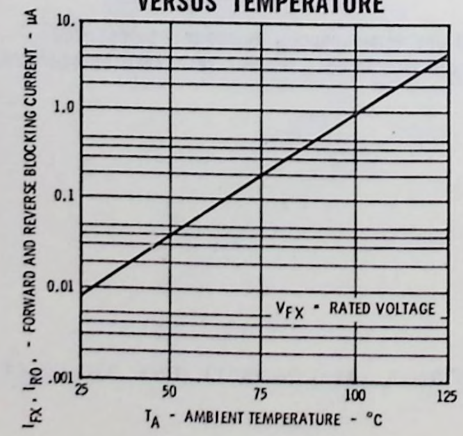
HOLDING CURRENT VERSUS REVERSE GATE CURRENT AND TEMPERATURE



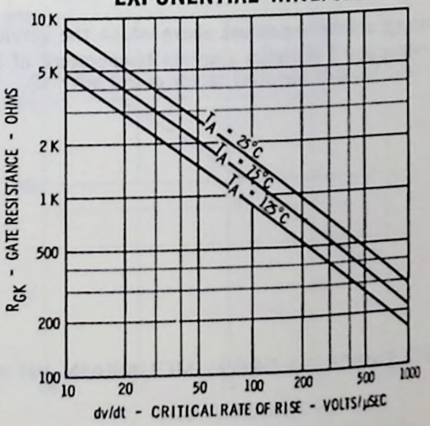
FORWARD AND REVERSE BLOCKING CURRENT VERSUS PERCENT OF RATED VOLTAGE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS TEMPERATURE

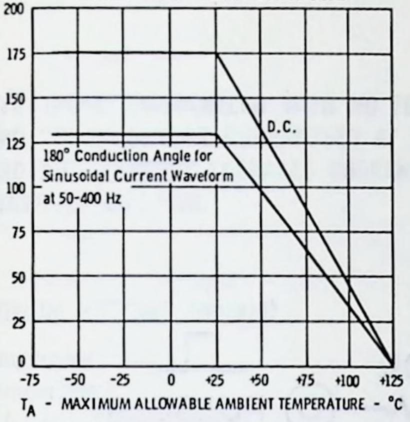


CRITICAL RATE OF RISE OF ANODE VOLTAGE FOR EXPONENTIAL WAVEFORM

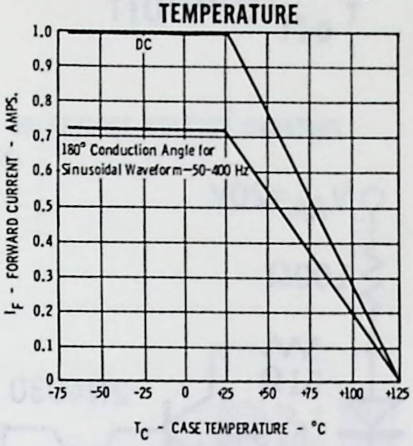


MAXIMUM RATINGS

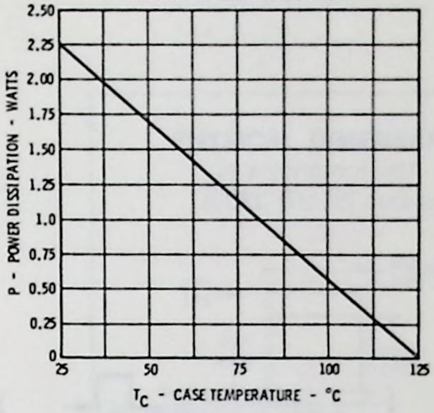
FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE



FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE

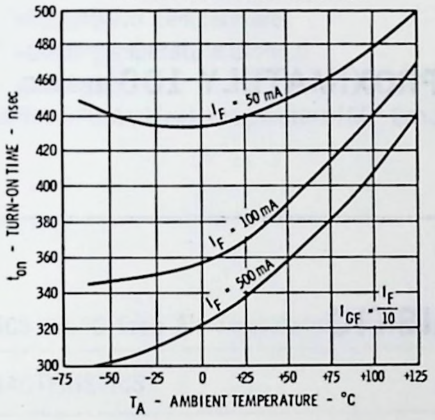


POWER DISSIPATION VERSUS CASE TEMPERATURE

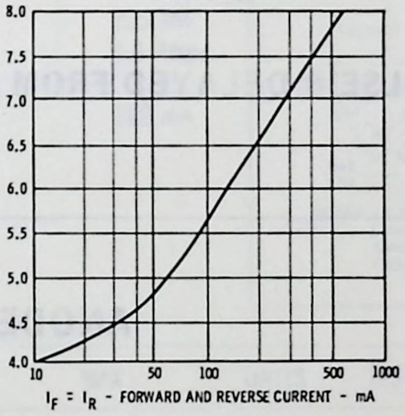


SWITCHING CHARACTERISTICS

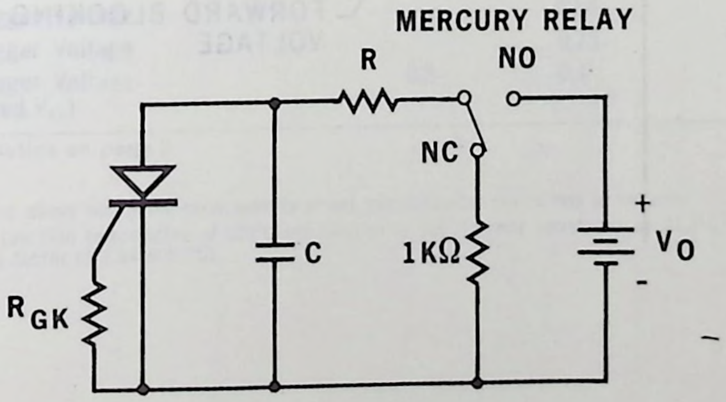
TURN-ON TIME VERSUS AMBIENT TEMPERATURE



TURN-OFF TIME VERSUS FORWARD AND REVERSE CURRENT



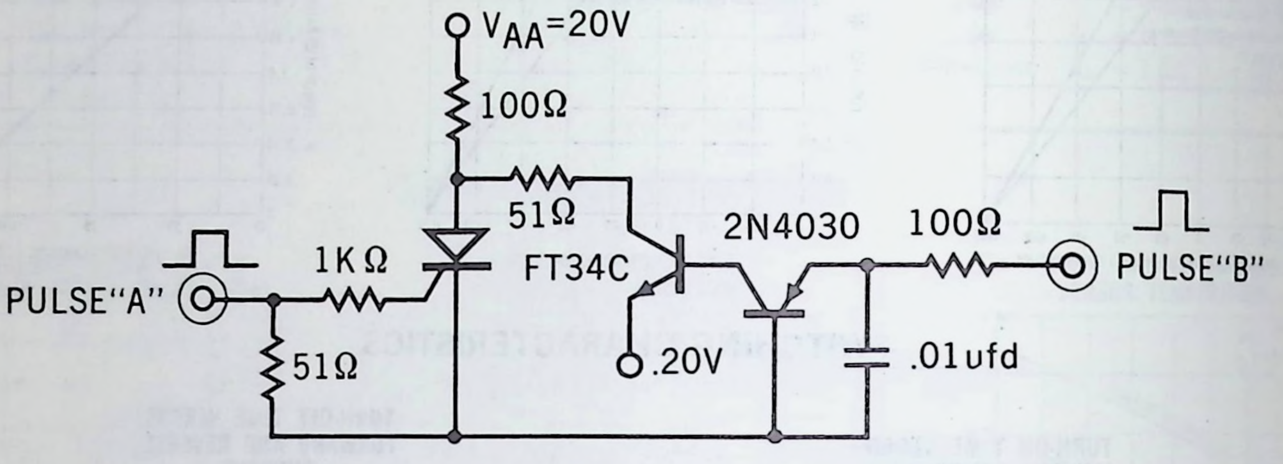
$\frac{dv}{dt}$ CIRCUIT



$$\frac{dv}{dt} = 0.632 \frac{V_O}{RC}$$

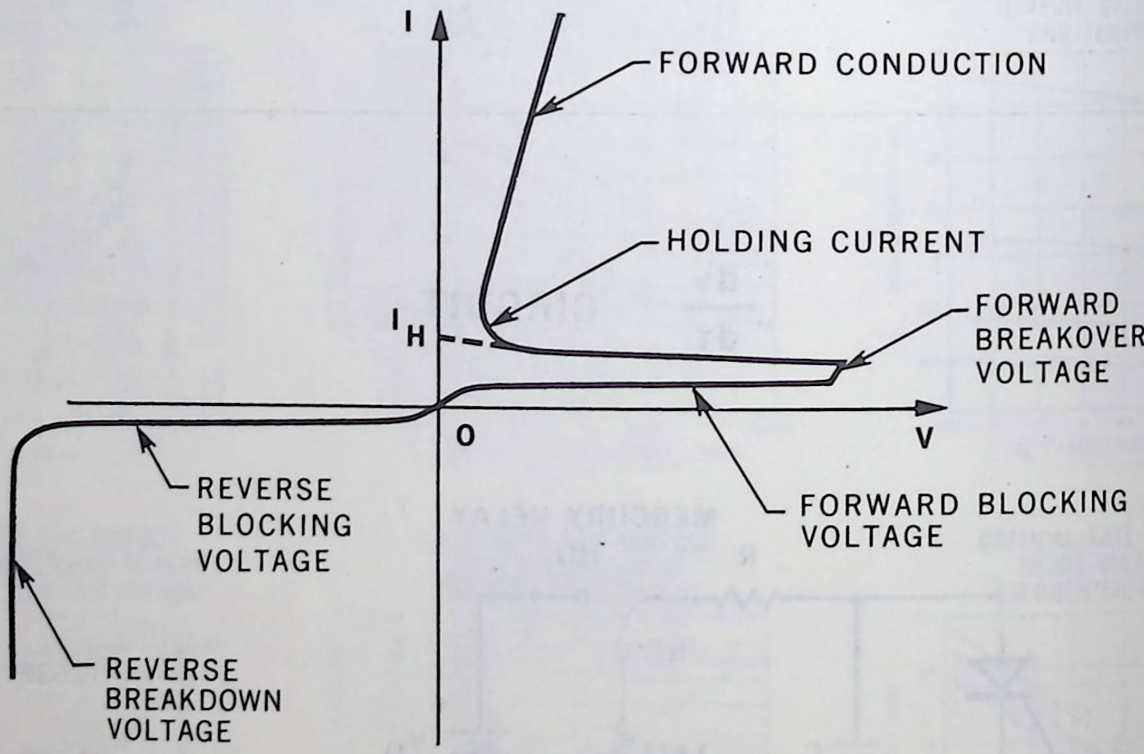
V_O = RATED VOLTAGE

t_{off} CIRCUIT


V_{AA}=20V
100Ω
51Ω
2N4030
100Ω
PULSE"A"
1KΩ
FT34C
PULSE"B"
51Ω
.20V
.01ufd

PULSE B DELAYED FROM PULSE A BY APPROXIMATELY 100 μsec.

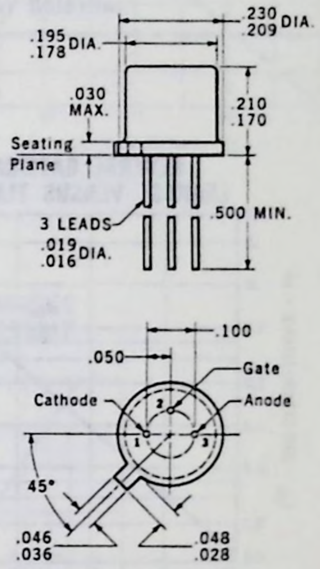
ANODE CHARACTERISTIC



2N4108 • 2N4109 • 2N4110
PNPN SILICON CONTROLLED RECTIFIERS
DIFFUSED SILICON PLANAR DEVICES

- **OPERATION TO 125°C GUARANTEED WITH NO FORWARD OR REVERSE VOLTAGE DERATING.**
- **LOW FORWARD "ON" VOLTAGE GUARANTEED AT 3 POINTS.**
- **LOW FORWARD AND REVERSE LEAKAGES GUARANTEED.**
- **PLANAR RELIABILITY BUILT IN.**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Anode internally connected to case
Package weight is 0.44 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	− 65°C to + 125°C
Operating Junction Temperature	− 65°C to + 125°C
Lead Temperature (Soldering, 10 sec. time limit)	+ 260°C Maximum

Maximum Power Dissipation

Average Gate Power Dissipation at 25°C Ambient Temperature (Note 2)	**0.1 Watt**

Maximum Currents

DC Forward Current at 25°C Case Temperature (Note 2)	1.0 Amp.
DC Forward Current at 25°C Ambient Temperature	235 mA
Surge Current at 25°C Ambient Temperature (Note 2) (½ cycle sine wave = 8.3 msec)	**4.0 Amps.**
Average Forward Current at 25°C Ambient Temperature 180° Conduction	180 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise specified)

SYMBOL	CHARACTERISTICS		MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{FX}	Forward Blocking Voltage **(T_A = − 65°C to + 125°C)**	2N4108	50			Volts	**I_{FX} = 0.05 μA**, R_{GK} = 1.0 kΩ
		2N4109	100			Volts	
		2N4110	200			Volts	
V_{RO}	Reverse Blocking Voltage **(T_A = − 65°C to + 125°C)**	2N4108	50			Volts	**I_{RO} = 0.05 μA**, R_{GK} = ∞
		2N4109	100			Volts	
		2N4110	200			Volts	
I_{FX}	Forward Blocking Current (at rated V_{FX})			8	50	nA	R_{GK} = 1.0 kΩ
I_{FX} (125°C)	Forward Blocking Current (at rated V_{FX})			5	20	μA	R_{GK} = 1.0 kΩ
I_{RO}	Reverse Blocking Current (at rated V_{RO})			8	50	nA	R_{GK} = ∞
I_{RO} (125°C)	Reverse Blocking Current (at rated V_{RO})			5	20	μA	R_{GK} = ∞
I_{GT}	Gate Trigger Current			0.060	**0.2**	mA	V_{AK} = 10V, R_L = 100Ω
I_{GT} (−55°C)	Gate Trigger Current			0.110	2.0	mA	V_{AK} = 10V, R_L = 100Ω
V_{GT}	Gate Trigger Voltage			0.58	0.8	Volts	V_{AK} = 10V, R_L = 100Ω
V_{GT} (−55°C)	Gate Trigger Voltage			0.75	1.1	Volts	V_{AK} = 10V, R_L = 100Ω
V_{GT} (125°C)	Gate Trigger Voltage **(at rated V_{FX})**		0.2	0.4		Volts	R_L = 10 kΩ

Additional Electrical Characteristics on page 2

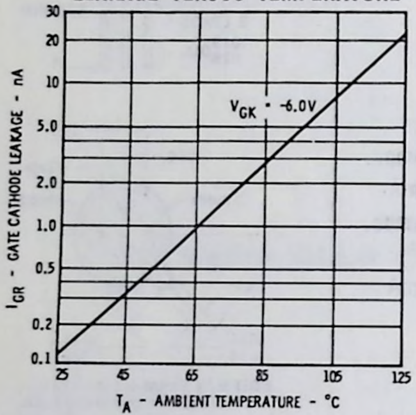
NOTES:
(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 44.5°C/Watt (derating factor of 22.5 mW/°C); junction to ambient thermal resistance of 350°C/W (derating factor of 2.84 mW/°C).

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise specified)

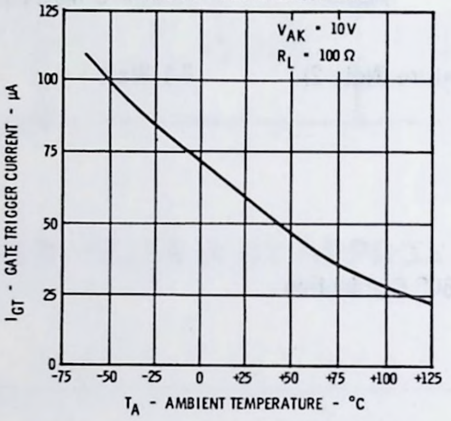
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	On Voltage		0.95	1.15	Volts	I_F = 175 mA
V_F	On Voltage		1.05	**1.2**	Volts	I_F = **250 mA**
V_F	On Voltage		1.2	**1.6**	Volts	I_F = **500 mA**
I_{HO}	Holding Current		0.7	2.0	mA	$R_G = \infty$, R_L = 1.0 KΩ
I_{GR}	Gate Leakage Current		0.13	25	nA	$I_F = 0$, $V_{GK} = -6.0V$
I_{GR} (125°C)	Gate Leakage Current		0.024	10	μA	$I_F = 0$, $V_{GK} = -6.0V$
t_{on}	Turn On Time		0.56	**1.5**	μs	$I_F \approx$ 200 mA, I_{GF} = 10 mA
t_{off}	Turn Off Time (see t_{off} circuit)		6.5	**15**	μs	$I_F = I_R \approx$ 200 mA
dv/dt	Critical Rate of Rise (at rated V_{FX})	75	200		Volts/μs	R_{GK} = 1 KΩ, R_L = 100 Ω

GATE CHARACTERISTICS

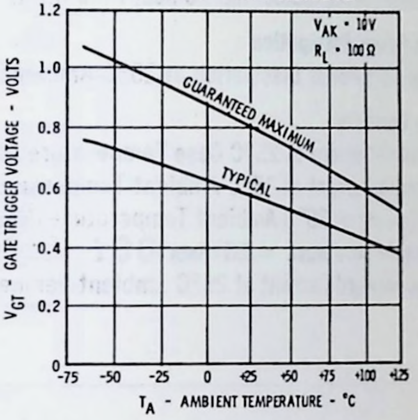
REVERSE GATE-CATHODE LEAKAGE VERSUS TEMPERATURE



GATE TRIGGER CURRENT VERSUS TEMPERATURE

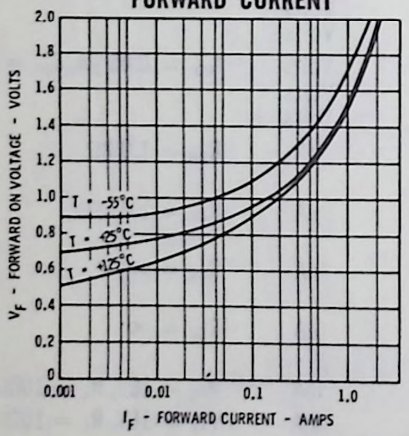


GATE TRIGGER VOLTAGE VERSUS TEMPERATURE

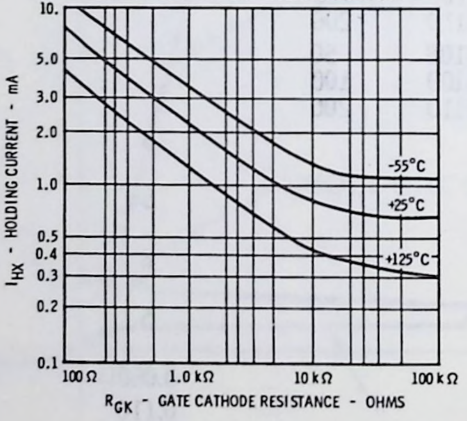


TYPICAL ELECTRICAL CHARACTERISTICS

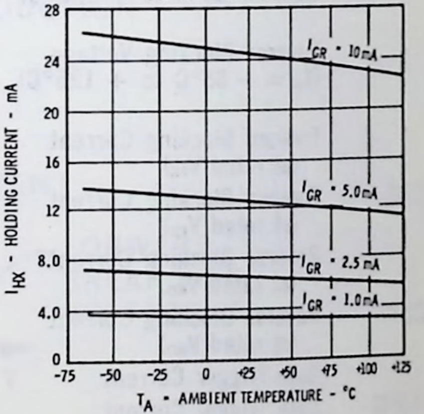
ON VOLTAGE VERSUS FORWARD CURRENT



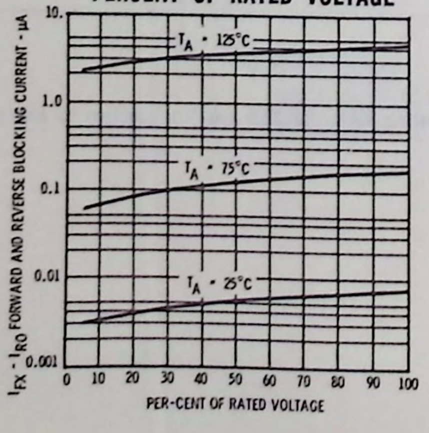
HOLDING CURRENT VERSUS GATE-CATHODE RESISTANCE



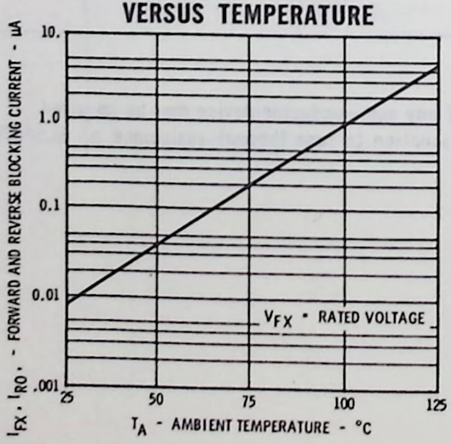
HOLDING CURRENT VERSUS REVERSE GATE CURRENT AND TEMPERATURE



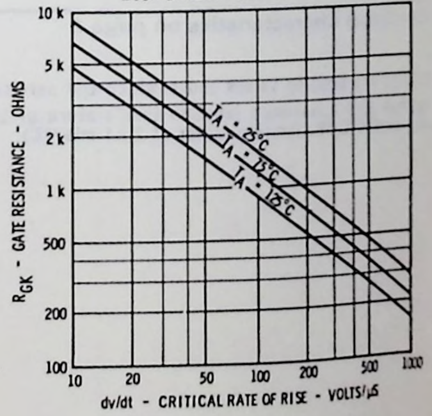
FORWARD AND REVERSE BLOCKING CURRENT VERSUS PERCENT OF RATED VOLTAGE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS TEMPERATURE

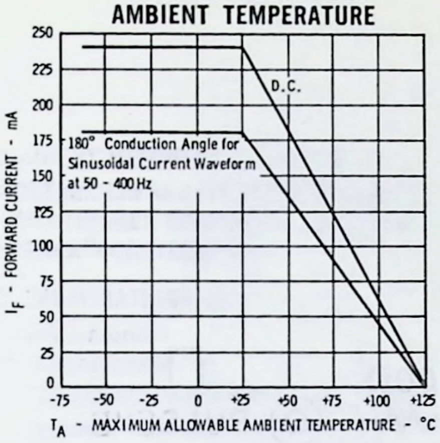


CRITICAL RATE OF RISE OF ANODE VOLTAGE FOR EXPONENTIAL WAVEFORM

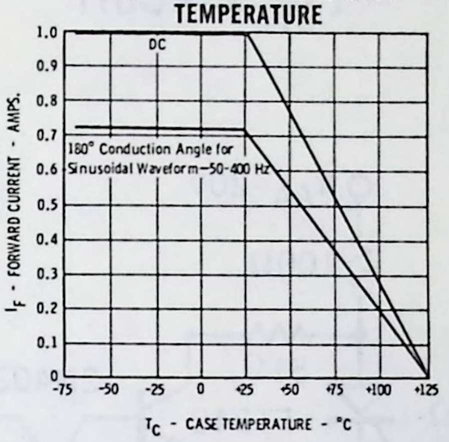


MAXIMUM RATINGS

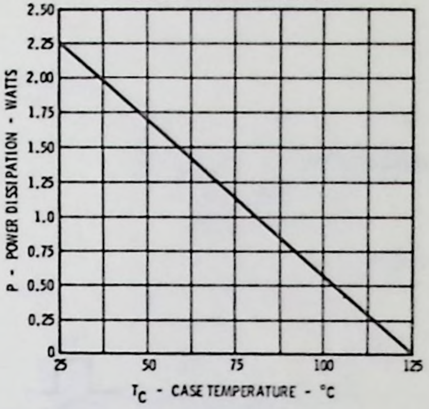
FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE



FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE

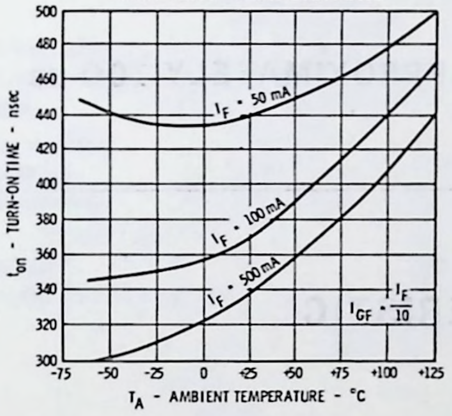


POWER DISSIPATION VERSUS CASE TEMPERATURE

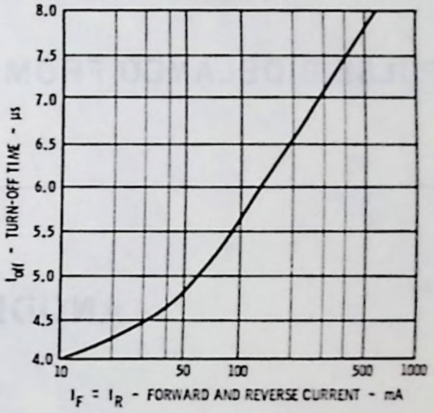


SWITCHING CHARACTERISTICS

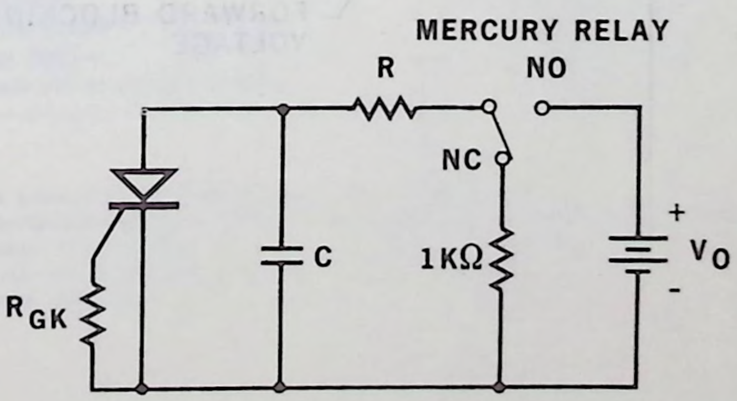
TURN-ON TIME VERSUS AMBIENT TEMPERATURE



TURN-OFF TIME VERSUS FORWARD AND REVERSE CURRENT



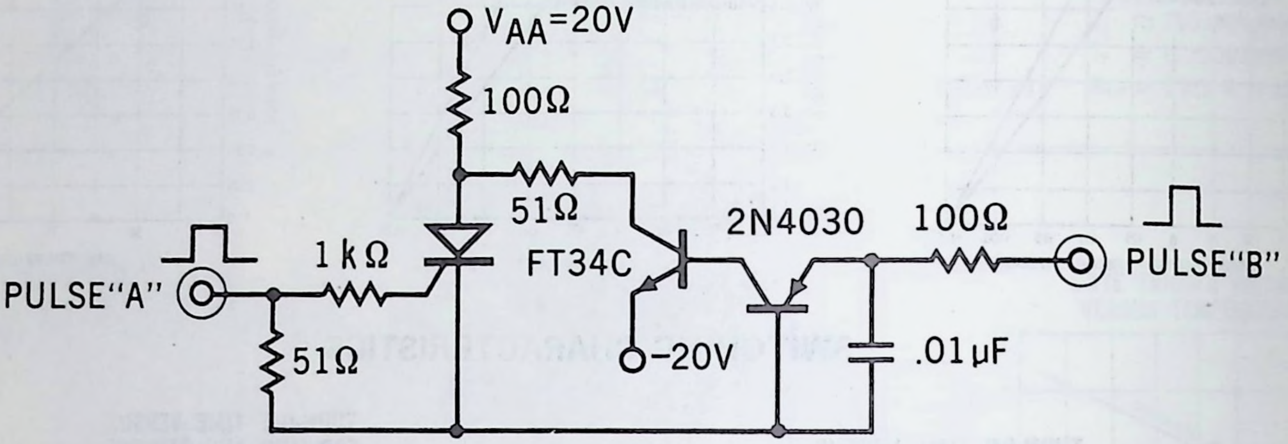
$\frac{dv}{dt}$ CIRCUIT



$$\frac{dv}{dt} = 0.632 \frac{V_O}{RC}$$

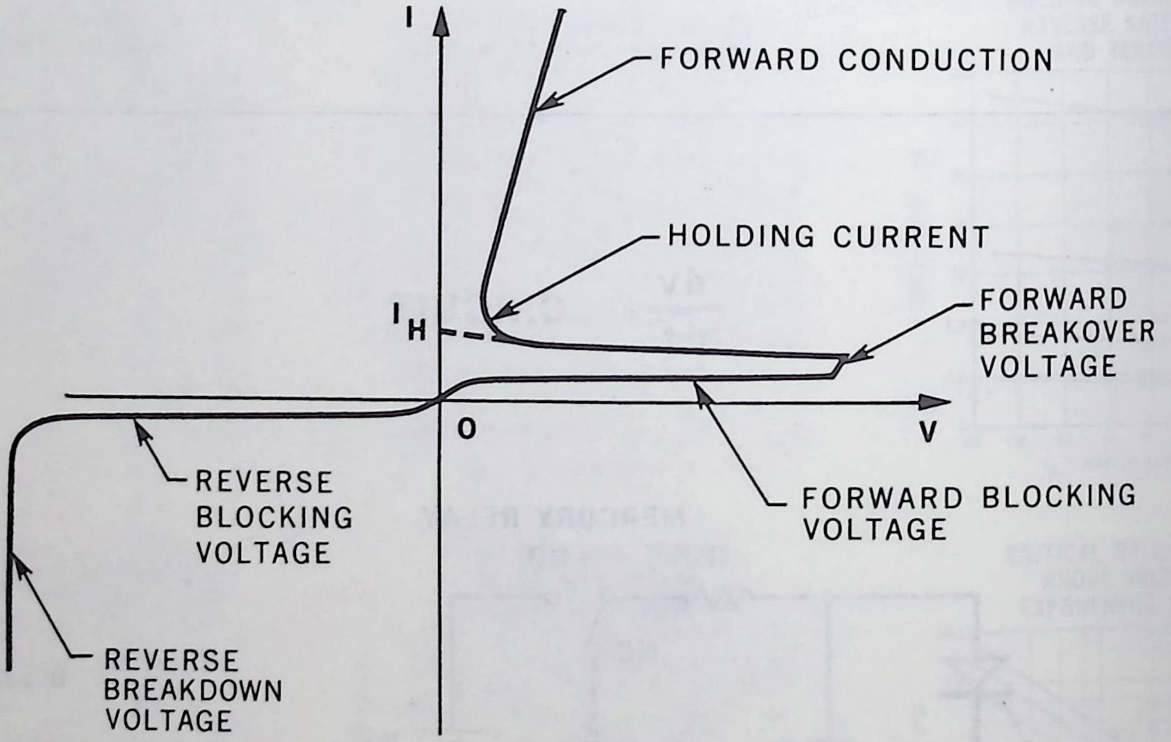
V_O = RATED VOLTAGE

t_{off} CIRCUIT


V_{AA}=20V
100Ω
51Ω
2N4030
100Ω
1 kΩ
FT34C
PULSE "A"
PULSE "B"
51Ω
-20V
.01 μF

PULSE B DELAYED FROM PULSE A BY APPROXIMATELY 100 μs

ANODE CHARACTERISTIC


I
FORWARD CONDUCTION
HOLDING CURRENT
I_H
FORWARD BREAKOVER VOLTAGE
0
V
REVERSE BLOCKING VOLTAGE
FORWARD BLOCKING VOLTAGE
REVERSE BREAKDOWN VOLTAGE

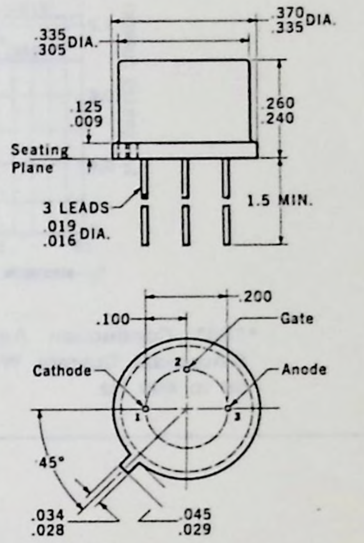
2N4212 THROUGH 2N4218

PNPN SILICON CONTROLLED RECTIFIERS

DIFFUSED SILICON PLANAR* THYRISTORS

- **FORWARD CURRENT RATING OF 1.25 AMPS D.C. AT $T_C = 85°C$**
- **BLOCKING VOLTAGE CAPABILITY THROUGH 300 VOLTS**
- **MAXIMUM GATE TRIGGER CURRENT OF 100 μA AT $T_C = 25°C$**
- **RELIABLE PLANAR*CONSTRUCTION**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES:
All dimensions in inches.
Leads are gold-plated Kovar.
Anode internally connected to case.
Package weight is 1.23 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures			
†Storage Temperature		T_{stg}	−65°C to +150°C
†Operating Junction Temperature		T_J	−65°C to +125°C
Maximum Currents			
rms Forward Current	$T_C = 85°C$	$I_{F(rms)}$	1.6 Amps
(180° Conduction Angle) (Note 2)	$T_A = 25°C$		490 mA
Continuous Forward Current	$T_C = 85°C$	$I_{F(DC)}$	1.25 Amps
	$T_A = 25°C$		355 mA
Average Forward Current	†$T_C = 85°C$	$I_{F(AV)}$	1.0 Amp
(180° Conduction Angle)(Note 2)	†$T_C = 105°C$		0.5 Amp
	$T_A = 25°C$		310 mA
†Surge Current	$T_C = 85°C$	$I_{FM(surge)}$	15 Amps
(½ cycle sine wave, 60 Hz peak)			
†Peak Forward Gate Current	$T_C = 25°$	I_{GFM}	0.1 Amp
(180° Conduction Angle)			
Maximum Gate Power ($T_C = 85°C$)			
†Peak Gate Power Dissipation		P_{GM}	0.1 Watt
†Average Gate Power Dissipation		$P_{GM(AV)}$	0.01 Watt
Maximum Voltages ($T_C = -65°C$ to 125°C)			
†Peak Reverse Gate Voltage		V_{GRM}	6.0 Volts
†Peak Forward and Reverse Blocking Voltages		V_{FM}, V_{RM}	**2N4212** 25 Volts
			2N4213 50 Volts
			2N4214 100 Volts
			2N4215 150 Volts
			2N4216 200 Volts
			2N4217 250 Volts
			2N4218 300 Volts

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
I_{FX}	Forward Blocking Current		40	200	nA	V_{AK} = Rated V_{FM}	$R_{GK} = 1.0\ k\Omega$
†I_{FX}(125°C)	Forward Blocking Current		20	200	μA	V_{AK} = Rated V_{FM}	$R_{GK} = 1.0\ k\Omega$
I_{RX}	Reverse Blocking Current		40	200	nA	V_{AK} = Rated V_{RM}	$R_{GK} = 1.0\ k\Omega$
†I_{RX}(125°C)	Reverse Blocking Current		20	200	μA	V_{AK} = Rated V_{RM}	$R_{GK} = 1.0\ k\Omega$
I_{GT}	Gate Trigger Current		40	100	μA	$V_{AA} = 7.0\ V$	$R_L = 100\ \Omega$
†I_{GT}(−65°C)	Gate Trigger Current		120	300	μA	$V_{AA} = 7.0\ V$	$R_L = 100\ \Omega$
V_{GT}	Gate Trigger Voltage		0.58	0.7	Volt	$V_{AA} = 7.0\ V$, $R_{GK} = 1.0\ k\Omega$, $R_L = 100\ \Omega$	
†V_{GT}(−65°C)	Gate Trigger Voltage		0.8	1.0	Volt	$V_{AA} = 7.0\ V$, $R_{GK} = 1.0\ k\Omega$, $R_L = 100\ \Omega$	
†V_{GT}(125°C)	Gate Trigger Voltage	0.1	0.21		Volt	V_{AA} = Rated V_{FM}, $R_{GK} = 1.0\ k\Omega$, $R_L = 100\ \Omega$	
I_{HX}	Holding Current		0.9		mA	$V_{AA} = 7.0\ V$	$R_{GK} = 1.0\ k\Omega$
†I_{HX}(−65°C)	Holding Current		1.75	7.0	mA	$V_{AA} = 7.0\ V$	$R_{GK} = 1.0\ k\Omega$
I_{GR}	Reverse Gate Current		.005	1.0	μA	$V_{GK} = -6.0\ V$	$I_A = 0$
†V_F	On Voltage (Note 4)		1.7	2.0	Volts	$I_F = 3.14\ A$	
dV/dt	Critical Rate of Rise of Anode Voltage		150		V/μs	V_{AA} = Rated V_{FM}	$R_{GK} = 500\ \Omega$

†JEDEC Registered Values.

*Planar is a patented Fairchild process.

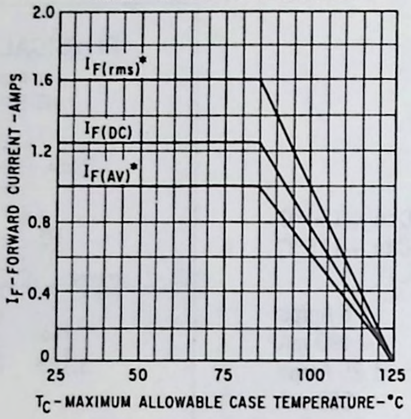
NOTES:
(1) These ratings are limiting values above which the reliability of the device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C with the maximum average power dissipation and a maximum junction to case thermal resistance of 18°C/Watt and a junction to ambient thermal resistance of 225°C/Watt.
(3) Ambient temperature derating curves are derived with no external heat sink connected.
(4) Pulse Conditions: length = 1ms max; duty cycle ≤ 1%.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

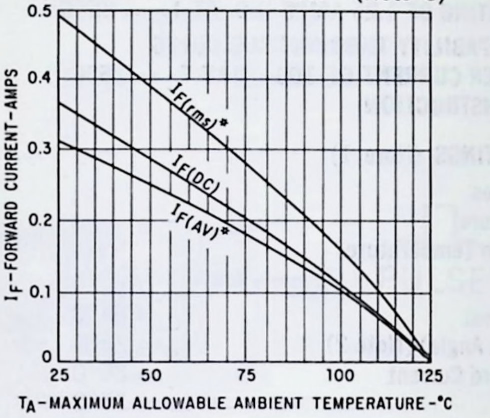
MAXIMUM RATINGS

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE CASE TEMPERATURE HALF WAVE CONDUCTION*



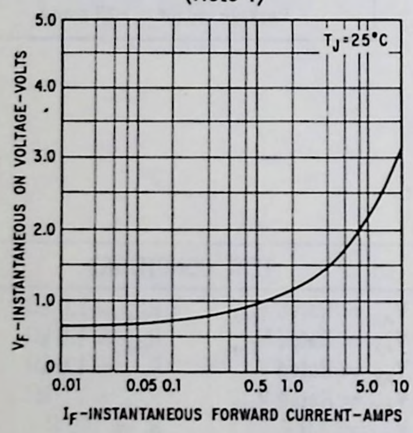
*180° Conduction Angle for Sinusoidal Current Waveform; 50 to 400 Hz.

FORWARD CURRENT VERSUS MAXIMUM ALLOWABLE AMBIENT TEMPERATURE HALF WAVE CONDUCTION* (Note 3)

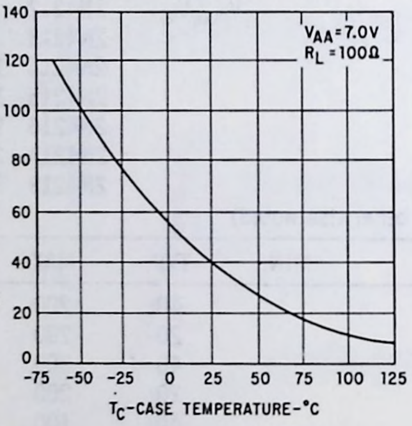


TYPICAL ELECTRICAL CHARACTERISTICS

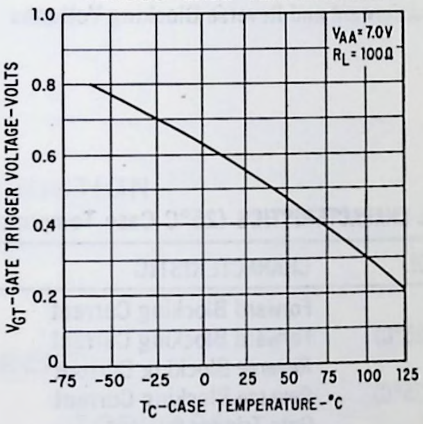
INSTANTANEOUS ON VOLTAGE VERSUS FORWARD CURRENT (Note 4)



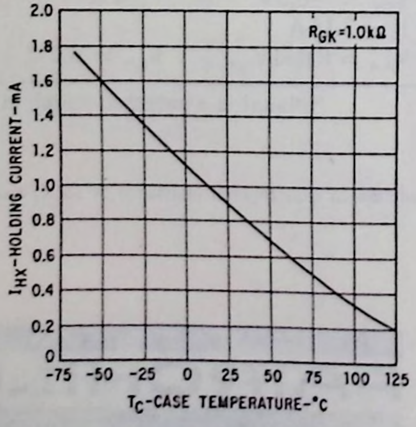
GATE TRIGGER CURRENT VERSUS CASE TEMPERATURE



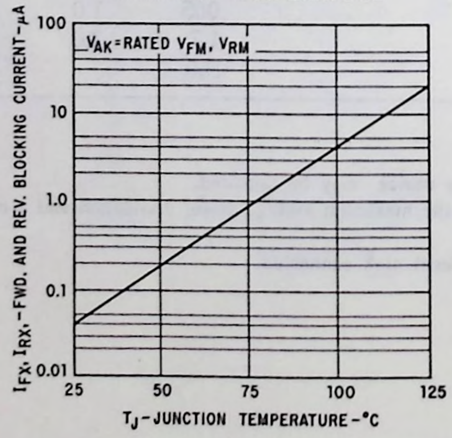
GATE TRIGGER VOLTAGE VERSUS CASE TEMPERATURE



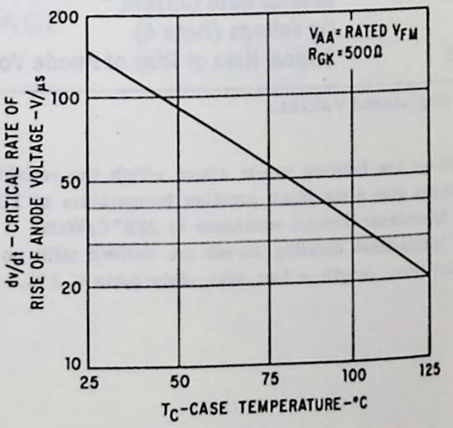
HOLDING CURRENT VERSUS CASE TEMPERATURE



FORWARD AND REVERSE BLOCKING CURRENT VERSUS JUNCTION TEMPERATURE



ALLOWABLE CRITICAL RATE OF RISE OF ANODE VOLTAGE VERSUS CASE TEMPERATURE



Microwave Transistors

MICROWAVE OPERATION ADVANTAGES AND RELIABILITY

Fairchild microwave transistors are NPN planar epitaxial transistors designed for both amplifier and oscillator applications covering the range .5GHz to 5.0GHz. The high f_{MAX} of these devices assures best possible performance and highest maximum available gain at L, S, and C band frequencies.

Fairchild step recovery diodes allow for extension of the oscillator capability into the X band range.

The planar process assures volume reproducibility with minimum lot to lot variation allowing for high volume production of microwave circuits and components.

MICROWAVE DEVICE SELECTION GUIDE

Device	Package	Typical f_{MAX} GHz	Typical M.A.G. 1 GHz	2 GHz	3 GHz	Oscillator P_O/Frequency (GHz)
MT1038	TO - 46 (CC)	2.8	9	3		1W @ 1
MT1038A	TO - 46	2.8	9	3		1W @ 1
MT1039	TO - 46	2.8	9	3		.8W @ 1
MT1050	CE Coax	3.6	11	5		.25W @ 1
MT1060	TO - 46	4.0	12	6		80mW @ 2
MT1060A	TO - 46	4.0	13	6		100mW @ 2
MT1061	TO - 72	4.5		6		See Data Sheet for Amplifier G_{PE} & N.F.
MT1061A	TO - 72	5.0	14	6		
MT1062	TO - 50	4.5	13	6.5	3.5	
MT1063	CD Channel		SEE	DATA	SHEET	
MT3833	TO - 50		13	6.5	3.5	100mW @ 2
MT3834	TO - 50		12	6		75mW @ 2
MT1070	CE Coax	6		9	5	20mW @ 2.5
MT1115	CE Coax	6		9.5	6	45mW @ 3
MT1116	CE Coax	6		12	9	20mW @ 4 90mW @ 3

OSCILLATOR PERFORMANCE

Frequency (GHz)	Output Power 10W	5W	2W	1W	.5W	250mW	100mW	50mW	25mW
.5	X	X	MT1038A	MT1039	MT1039	MT1060A	MT1060	MT1060	MT1060
1.0		X	X	MT1038/A	MT1039	MT1060/A	MT1060	MT1060	MT1060
1.5			X	X	MT1038A	MT1039	MT1060	MT1060	MT1060
2.0				X	X	MT1050	MT3833	MT3834	MT3834
2.5					X	X	MT1050	MT1070	MT1070
3.0						X	MT1116	MT1115	MT1070
3.5							X	MT1116	MT1115
4.0								X	MT1116
5.0								X	

X being developed

AMPLIFIER CHARACTERISTICS

Frequency (GHz)	Maximum Available Gain (db)* 18	15	12	9	6.5	3
.5	MT1060 MT1061	MT1038 MT1039				
1.0			MT1060 MT1061	MT1038/A		
2.0				MT1070	MT1060 MT1062 MT1050	MT1038
3.0				MT1116	MT1070	MT1050 MT1062
4.0					MT1116	MT1115
5.0						MT1116

*M.A.G. at $f_o = 20 \log_{10} \frac{f_{max}}{f_o}$

MICROWAVE TRANSISTOR NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
FGC1001	10-1	MT1060A	10-9	MT1115	10-15
MT1038	10-5	MT1061	10-9	MT1116	10-15
MT1038A	10-5	MT1061A	10-9	MT3833	10-17
MT1039	10-5	MT1062	10-13	MT3834	10-17
MT1050	10-5	MT1063	10-9		
MT1060	10-9	MT1070	10-14		

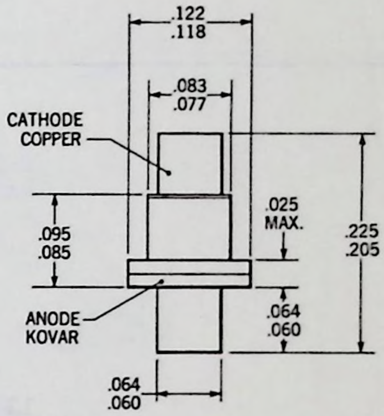
FGC1001

STEP RECOVERY DIODE

FOR MICROWAVE HARMONIC GENERATION

GENERAL DESCRIPTION — The Fairchild FGC1001 Step Recovery Diode is a silicon epitaxial passivated mesa device designed to enhance minority carrier storage in the forward direction and to force picosecond cessation of the reverse conduction current. This very fast transition time makes this Step Recovery Diode useful for harmonic generation, time delay and pulse sharpening.

PHYSICAL DIMENSIONS



ABSOLUTE MAXIMUM RATINGS (Note 1)

Thermal Resistance (Junction to Case)	75°C/W
Operation Temperature Range	−65°C to +175°C
Storage Temperature Range	−65°C to +175°C
RF Input Power ($T_A = 25°C$)	400 mW

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
t_t	Transition Time		70	100	ps	$I_F = 10$ mA	$V_R = 10$ V
τ	Lifetime	6	14		ns	$I_F = 10$ mA	$I_R = 6.0$ mA
C_O	Capacitance		0.9	1.3	pF	$V_R = 0$ V	f = 1.0 MHz
BV	Breakdown Voltage	20	25		Volts	$I_R = 10\ \mu A$	
I_R	Leakage Current		1.0	100	nA	$V_R = 10$ V	
I_F	Forward Current	75	200		mA	$V_F = 1.0$ V	

NOTES:

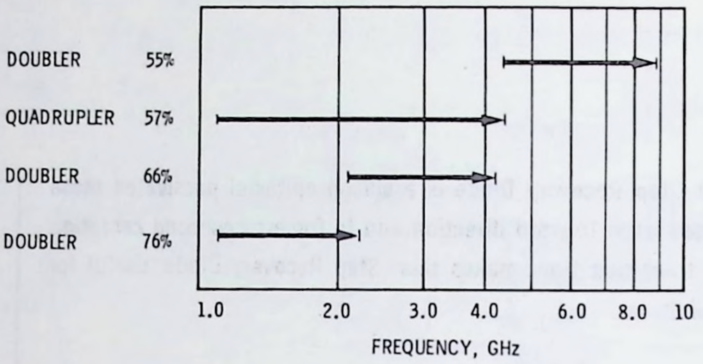
1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

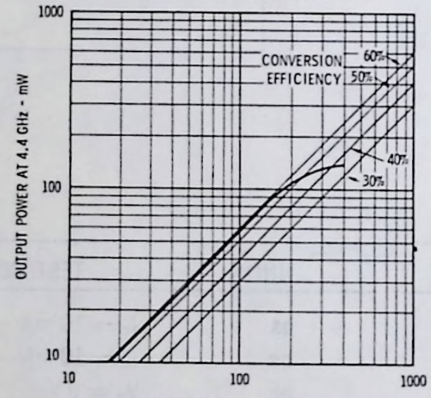
FAIRCHILD DIODE FGC1001

A SUMMARY OF TYPICAL MULTIPLIER EFFICIENCIES

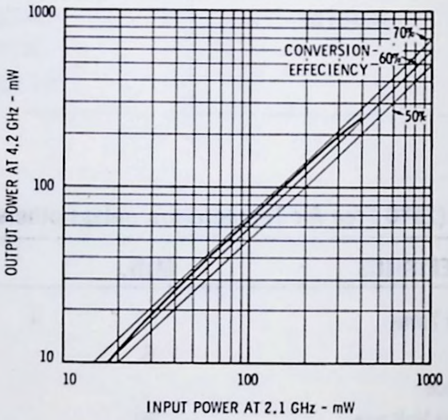


TYPICAL PERFORMANCE CURVES

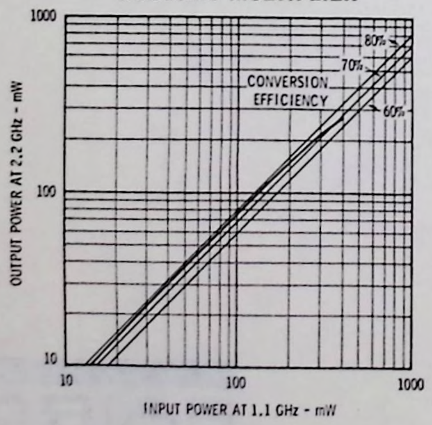
1.1 TO 4.4 GHz QUADRUPLER MULTIPLIER



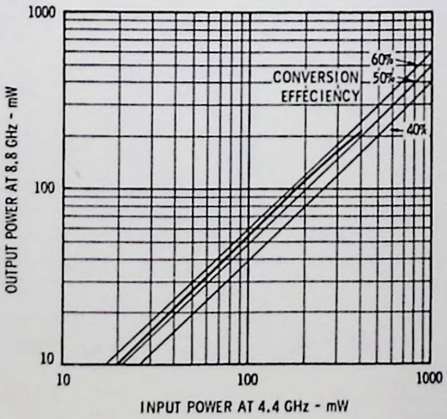
2.1 TO 4.2 GHz DOUBLER MULTIPLIER



1.1 TO 2.2 GHz DOUBLER MULTIPLIER

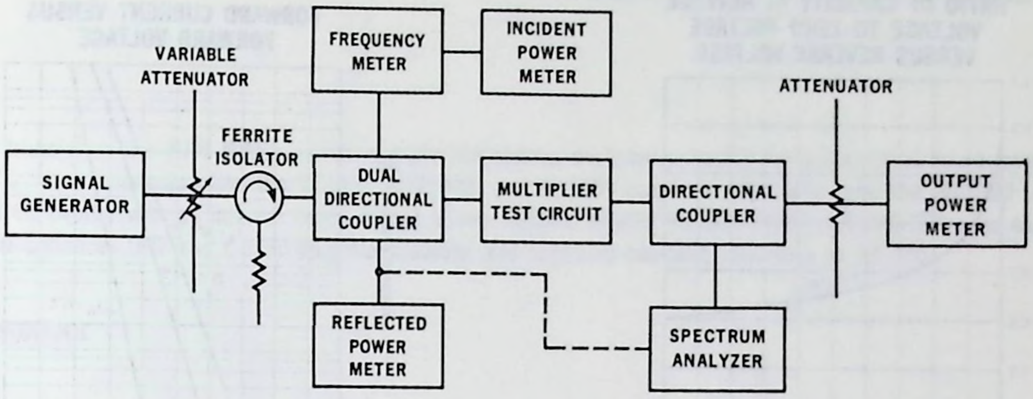


4.4 TO 8.8 GHz DOUBLER MULTIPLIER

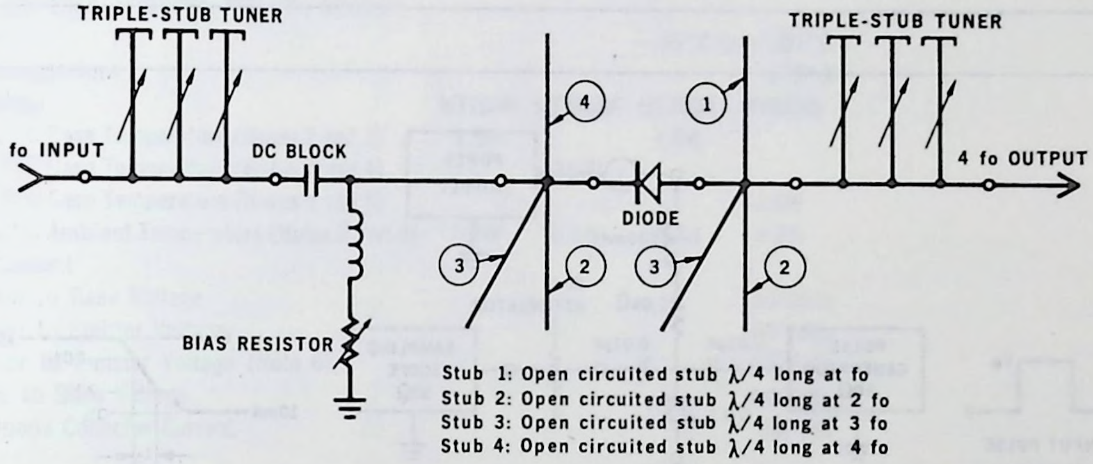


FAIRCHILD DIODE FGC1001

HARMONIC GENERATION TEST EQUIPMENT SET-UP


VARIABLE ATTENUATOR
FREQUENCY METER
INCIDENT POWER METER
ATTENUATOR
FERRITE ISOLATOR
SIGNAL GENERATOR
DUAL DIRECTIONAL COUPLER
MULTIPLIER TEST CIRCUIT
DIRECTIONAL COUPLER
OUTPUT POWER METER
REFLECTED POWER METER
SPECTRUM ANALYZER

SCHEMATIC DIAGRAM OF QUADRUPLER TEST CIRCUIT

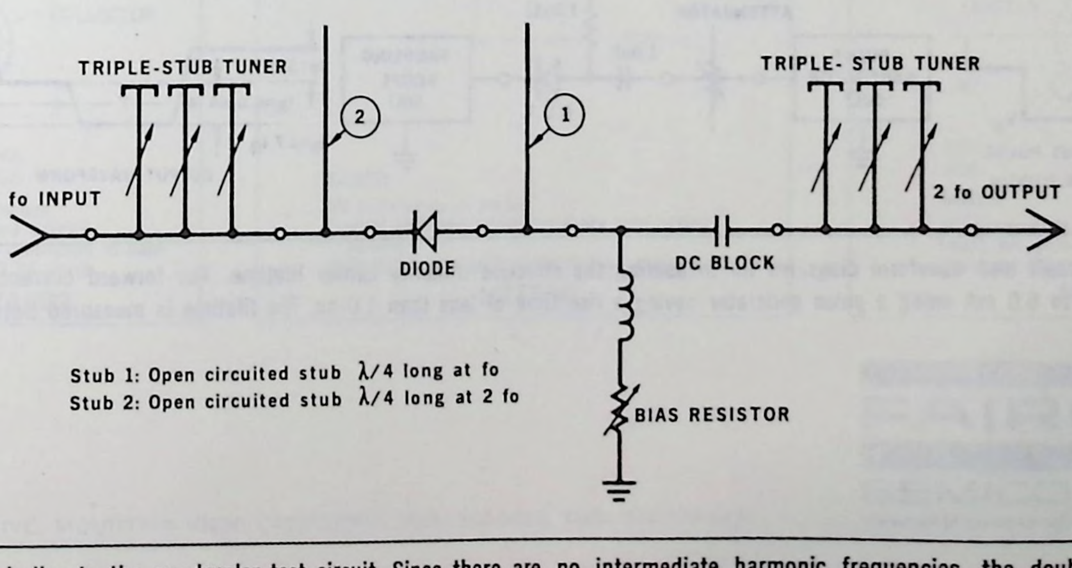

TRIPLE-STUB TUNER
TRIPLE-STUB TUNER
fo INPUT
DC BLOCK
4 fo OUTPUT
④
①
DIODE
③
②
③
②
BIAS RESISTOR

Stub 1: Open circuited stub $\lambda/4$ long at fo
Stub 2: Open circuited stub $\lambda/4$ long at 2 fo
Stub 3: Open circuited stub $\lambda/4$ long at 3 fo
Stub 4: Open circuited stub $\lambda/4$ long at 4 fo

The quadrupler test circuit may be described in the following manner. The stubs 1, 2, 3 and 4 should be set so that they are approximately one quarter wavelength long at the fundamental, second, third and fourth harmonics respectively. These shunt stubs will then act as simple filter circuits at the quarter wavelength frequencies. Stub 1 will prevent the input frequency from entering the output circuit, while stub 4 will prevent the output frequency from entering the input circuit. Stubs 2 and 3 will prevent the second and third harmonics from entering either the input or output circuits and will allow substantial currents to flow through the diode at these frequencies. This latter characteristic approximately fulfills the condition for idler circuits. The physical location of the stubs should be as close to the diode as possible.

The input triple stub tuner is used to match the diode at the fundamental frequency to the input circuit while the output triple stub tuner is used to match the diode at the fourth harmonic to the output circuit. The bias resistor will affect the impedance and operating point of the diode. Iterative adjustment of the bias resistor and input and output tuners is necessary for optimum conversion efficiency.

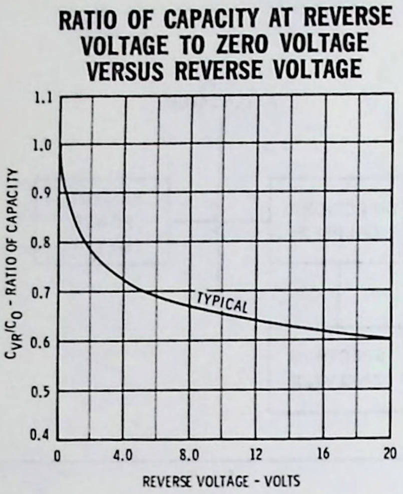
SCHEMATIC DIAGRAM OF DOUBLER TEST CIRCUIT

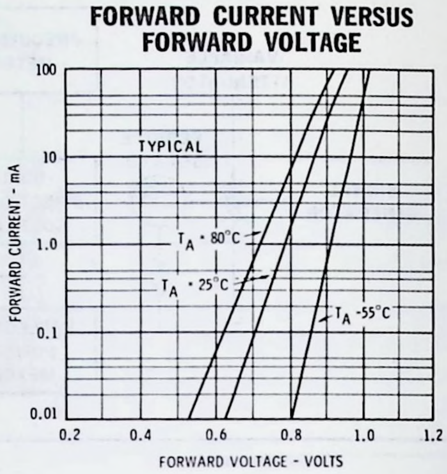

TRIPLE-STUB TUNER
TRIPLE- STUB TUNER
②
①
fo INPUT
2 fo OUTPUT
DIODE
DC BLOCK
BIAS RESISTOR

Stub 1: Open circuited stub $\lambda/4$ long at fo
Stub 2: Open circuited stub $\lambda/4$ long at 2 fo

The doubler test circuit is similar to the quadrupler test circuit. Since there are no intermediate harmonic frequencies, the doubler test circuit and tuning procedure is much simpler than the quadrupler test circuit. In all other respects to doubler it operates in a similar manner to the quadrupler.

FAIRCHILD DIODE FGC1001


RATIO OF CAPACITY AT REVERSE VOLTAGE TO ZERO VOLTAGE VERSUS REVERSE VOLTAGE


FORWARD CURRENT VERSUS FORWARD VOLTAGE

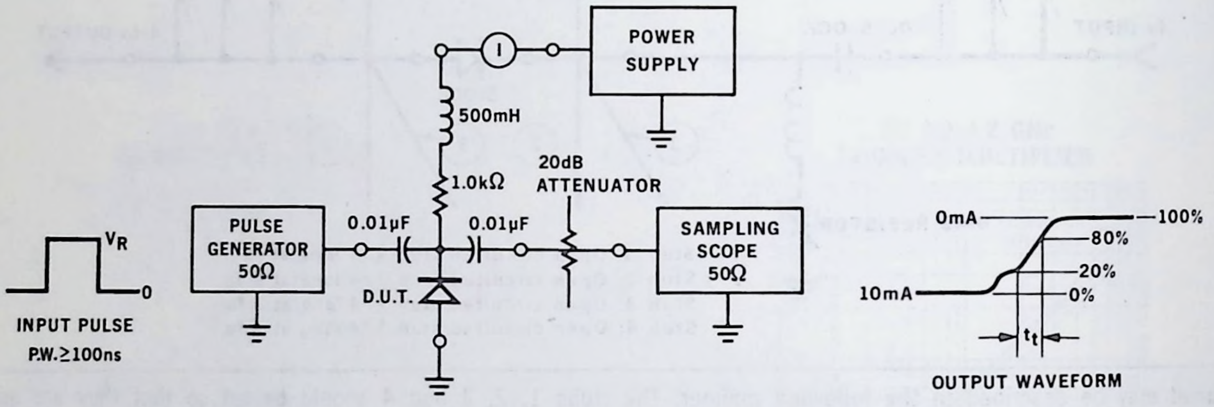

POWER SUPPLY
I
500mH
1.0kΩ
20dB ATTENUATOR
V_R
0
INPUT PULSE
P.W.≥100ns
PULSE GENERATOR 50Ω
0.01µF
0.01µF
D.U.T.
SAMPLING SCOPE 50Ω
0mA
10mA
100%
80%
20%
0%
t_t
OUTPUT WAVEFORM

Figure 1 shows the test circuit and waveform diagrams for measuring the transition time. The forward current is adjusted to 10 mA. The reverse voltage is adjusted to 10 V using a pulse generator having a rise time of less than 1.0 ns. The transition time, t_t, is measured between the 20% and 80% points on the falling edge of the forward current waveform.

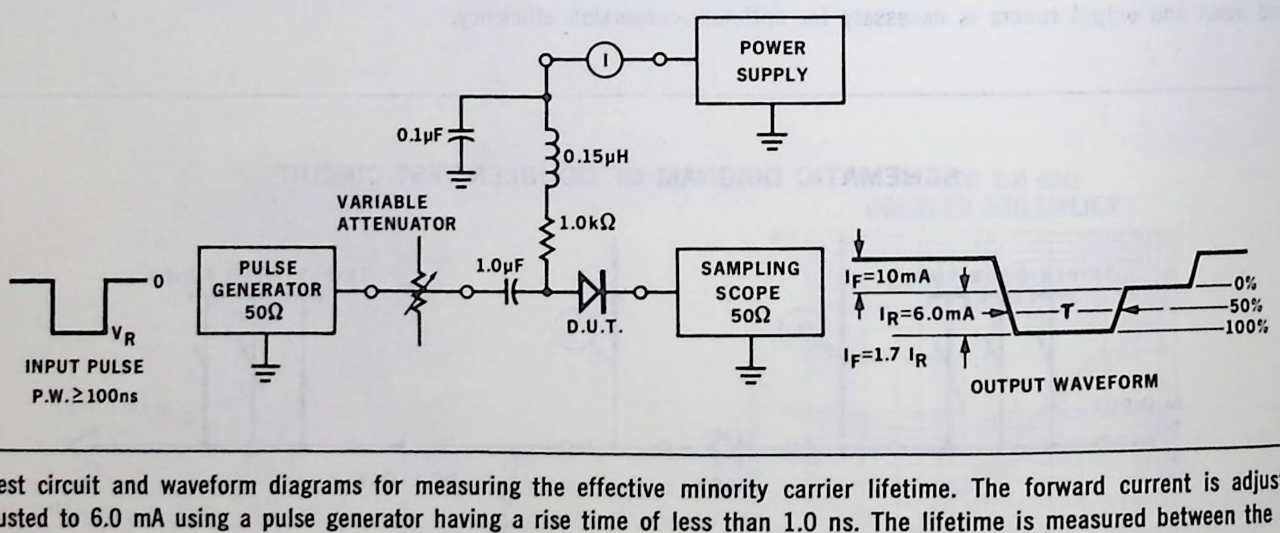

POWER SUPPLY
I
0.1µF
0.15µH
VARIABLE ATTENUATOR
1.0kΩ
0
V_R
INPUT PULSE
P.W.≥100ns
PULSE GENERATOR 50Ω
1.0µF
D.U.T.
SAMPLING SCOPE 50Ω
I_F=10mA
I_R=6.0mA
T
I_F=1.7 I_R
0%
50%
100%
OUTPUT WAVEFORM

Figure 2 shows the test circuit and waveform diagrams for measuring the effective minority carrier lifetime. The forward current is adjusted to 10 mA. The reverse current is adjusted to 6.0 mA using a pulse generator having a rise time of less than 1.0 ns. The lifetime is measured between the 50% points on the reverse current pulse.

MT1038 • MT1038A • MT1039 • MT1050

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION: These transistors are NPN silicon planar epitaxial transistors, designed primarily for large signal microwave applications. The high gain bandwidth products plus low $r_b'C_c$ time constants make the MT1038, MT1038A, and MT1039 usable to 1500 MHz; and the MT1050 usable to 2.5 GHz. The MT1038A is offered in a TO-46 header with an internal heatsink that allows HIGHER POWER DISSIPATION at ELEVATED case temperatures. The MT1050 is offered in a coaxial package that enhances UHF and L-band amplifier stability, and increases oscillator efficiency to 2.5 GHz.

- **HIGH GAIN - - BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$**
- **HIGH f_{max}**
- **LOW - - PARASITIC, COAXIAL PACKAGE (MT1050)**
- **GUARANTEED OSCILLATOR POWER TO 2 GHz**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures (MT1038, MT1038A, MT1039, MT1050)

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	175°C

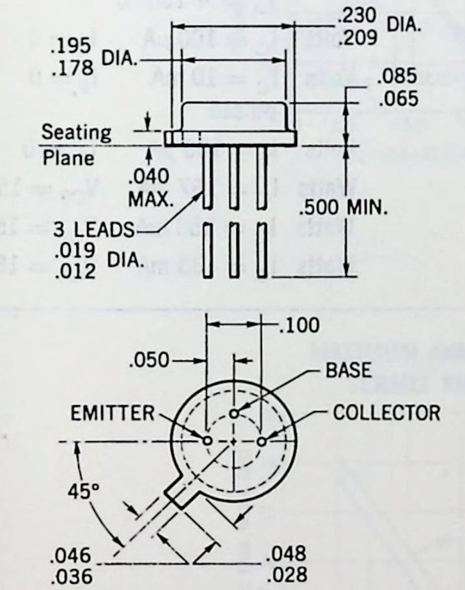
Maximum Power Dissipation	**MT1038**	**MT1038A**	**MT1039**	**MT1050**
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.5W		1.5W	
at 25°C Case Temperature (Notes 2 and 4)		2.0W		
at 75°C Case Temperature (Notes 2 and 5)				2.0W
at 25°C Ambient Temperature (Notes 2 and 3)	0.3W	0.3W	0.3W	0.3W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 6)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	250 mA

PHYSICAL DIMENSIONS

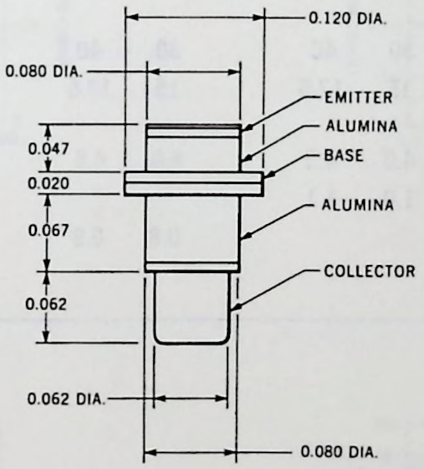
in accordance with
JEDEC (TO-46) outline


.230
.209 DIA.
.195
.178 DIA.
.085
.065
Seating Plane
.040 MAX.
.500 MIN.
3 LEADS
.019
.012 DIA.
.100
.050
BASE
EMITTER
COLLECTOR
45°
.046
.036
.048
.028

NOTES: All dimensions in inches
Leads are gold-plated KOVAR
Collector internally connected to case
Package weight is 0.36 gram

MT1038 • MT1039

PHYSICAL DIMENSIONS

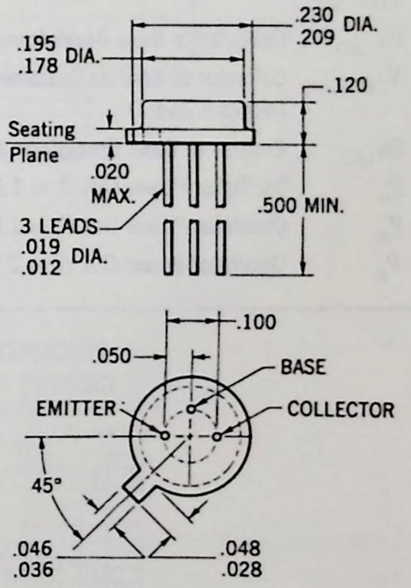

0.120 DIA.
0.080 DIA.
EMITTER
ALUMINA
BASE
ALUMINA
COLLECTOR
0.047
0.020
0.067
0.062
0.062 DIA.
0.080 DIA.

NOTES:
All dimensions in inches
Emitter and base connections are gold-plated KOVAR
Collector is internally connected to copper stud

MT1050

PHYSICAL DIMENSIONS

similar to
JEDEC (TO-46) outline


.230
.209 DIA.
.195
.178 DIA.
.120
Seating Plane
.020 MAX.
.500 MIN.
3 LEADS
.019
.012 DIA.
.100
.050
BASE
EMITTER
COLLECTOR
45°
.046
.036
.048
.028

NOTES:
All dimensions in inches
Leads are gold-plated KOVAR
Collector internally connected to case

MT1038A

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

HIGH FREQUENCY CHARACTERISTICS

SYMBOL	CHARACTERISTICS	MT1038 MT1038A MIN.	TYP.	MAX.	MT1039 MIN.	TYP.	MAX.	MT1050 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
f_T	Gain Bandwidth Product (f = 100 MHz)	.95	1.1		.95	1.1		.95	1.1		GHz	10V	50 mA
$r_b'C_c$	Base-Collector Time Constant (79.8 MHz)		5.5	6.5		5.5	6.5				ps	10V	20 mA
									3.5	4.5	ps	10V	30 mA
f_{max}	Maximum Frequency of Oscillation (Note 9)	2.5	2.8		2.5	2.8		3.0	3.6		GHz	10V	50 mA
MAG	Maximum Available Gain (f = 1 GHz)		9			9			11		dB	10V	50 mA
MAG	Maximum Available Gain (f = 2 GHz)		3			3			5		dB	10V	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MT1038 MT1038A MIN.	TYP.	MAX.	MT-1039 MIN.	TYP.	MAX.	MT1050 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 7)	20	40	120	20	40	120	20	40	120		$I_C = 10$ mA	$V_{CE} = 5.0$V
$V_{CE(sat)}$	Collector Saturation Voltage (pulsed, Note 7)		0.2	0.5		0.2	0.5		0.2	0.5	Volts	$I_C = 250$ mA	$I_B = 25$ mA
$V_{BE(sat)}$	Base Saturation Voltage (pulsed, Note 7)		0.89	0.95		0.89	0.95		0.89	0.95	Volts	$I_C = 100$ mA	$I_B = 50$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	9.5	11		9.5	11		9.5	11			$I_C = 50$ mA	$V_{CE} = 10$V
C_{cb}	Collector Base Capacitance		4	6.0		4	6		4	6	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{eb}	Emitter Base Capacitance		8	12		8	12		8	12	pF	$V_{EB} = +0.5$ V	$I_C = 0$
I_{CBO}	Collector Cutoff Current		0.01	50		0.01	50		0.01	50	nA	$V_{CB} = 10$ V	$I_E = 0$
I_{CBO} (125°C)	Collector Cutoff Current		0.3	1.0		0.3	1.0		0.3	1.0	μA	$V_{CB} = 10$ V $T_A = +150$°C	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30	40		30	40		30	40		Volts	$I_C = 100$ μA	$I_E = 0$
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage (Notes 6 and 7)	15	17.5		15	17.5		15	17.5		Volts	$I_C = 10$ mA pulsed	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	4.5		4.0	4.5		4.0	4.5		Volts	$I_E = 100$ μA	$I_C = 0$
P_o	Oscillator Power Out (f = 1.0 GHz)	1.0	1.1								Watts	$I_C = 167$ mA	$V_{CB} = 15$V
P_o	Oscillator Power Out (f = 1.0 GHz)				0.8	0.9					Watts	$I_C = 150$ mA	$V_{CB} = 15$V
P_o	Oscillator Power Out (f = 2.0 GHz) (Note 8)							0.2	0.25		Watts	$I_C = 133$ mA	$V_{CB} = 15$V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 100°C/Watt (derating factor of 10mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(4) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 75°C/Watt (derating factor of 13.3 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(5) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

(6) Rating refers to a high-current point where collector to emitter voltage is lowest.

(7) Pulse Conditions: length = 300 μs; duty cycle = 1%.

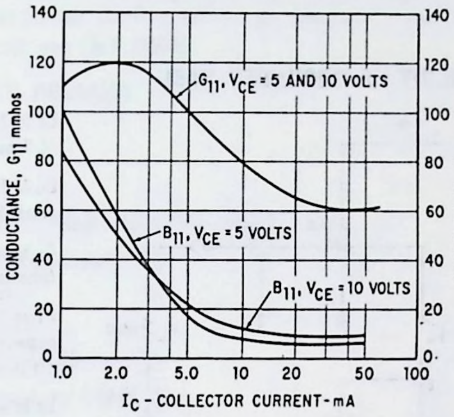
(8) I_C is adjusted between 75 mA and 133 mA for optimum power output.

(9) Calculated from: $f_{max} = \sqrt{\frac{f_T}{8 \pi r_b' C_c}}$

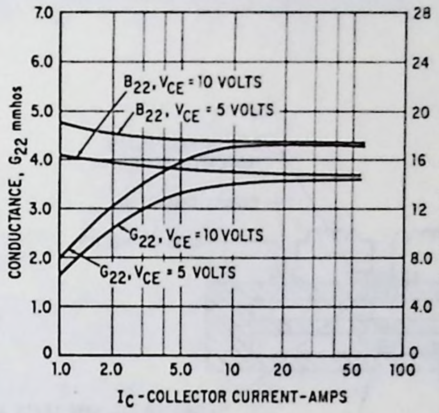
AMPLIFIER CHARACTERISTICS

Y PARAMETERS VERSUS COLLECTOR CURRENT — 500 MHz COMMON EMITTER

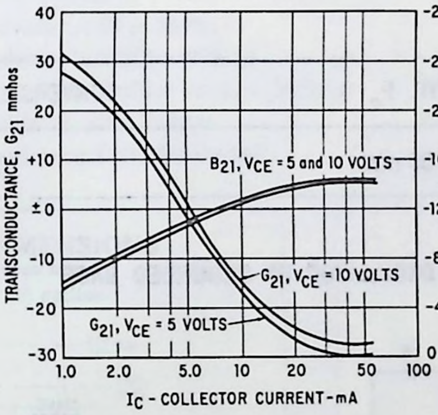
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



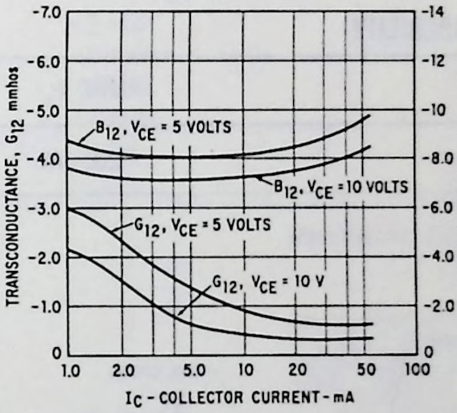
Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT



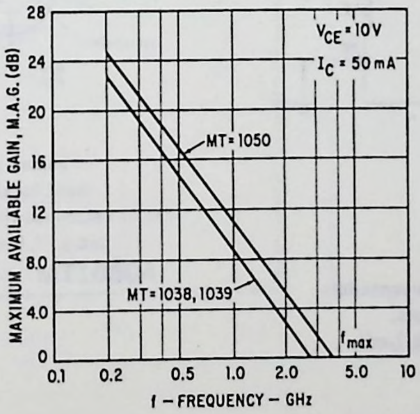
Y_{21E}, FORWARD TRANSFER ADMITTANCE, OUTPUT SHORT CIRCUIT



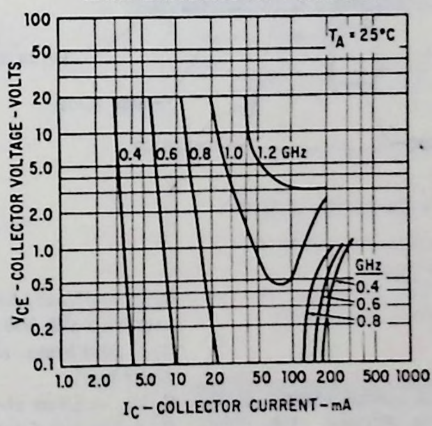
Y_{12E}, REVERSE TRANSFER ADMITTANCE, INPUT SHORT CIRCUIT



MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY



CONTOURS OF CONSTANT GAIN-BANDWIDTH PRODUCT

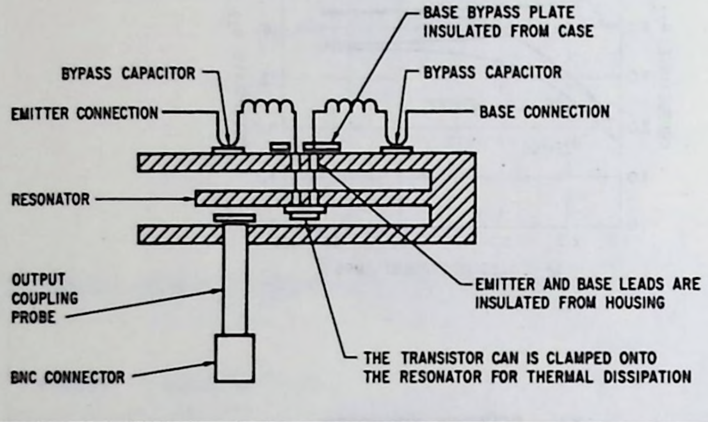


OSCILLATOR CHARACTERISTICS

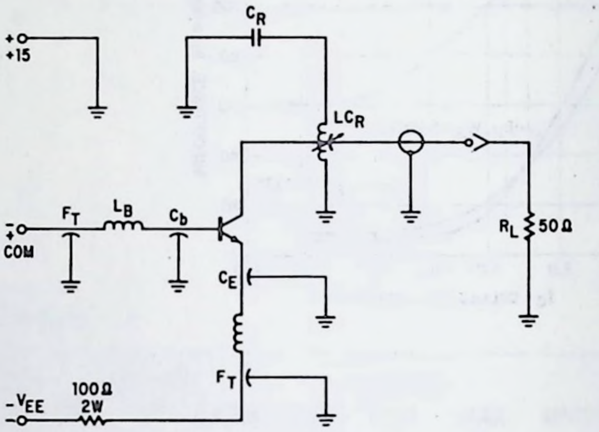
1 GHz OSCILLATOR CAPABILITY

PRODUCT	MIN. P_o	TYP. P_o	CONVERSION EFFICIENCY
MT1038	1.0 W	1.1 W	40%
MT1038A	1.0 W	1.1 W	40%
MT1039	0.8 W	0.9 W	35%

1 GHz TEST OSCILLATOR


BASE BYPASS PLATE INSULATED FROM CASE
BYPASS CAPACITOR
BYPASS CAPACITOR
EMITTER CONNECTION
BASE CONNECTION
RESONATOR
OUTPUT COUPLING PROBE
EMITTER AND BASE LEADS ARE INSULATED FROM HOUSING
BNC CONNECTOR
THE TRANSISTOR CAN IS CLAMPED ONTO THE RESONATOR FOR THERMAL DISSIPATION

1 GHz TEST CIRCUIT RF GROUNDED BASE


+15
C_R
LC_R
F_T
L_B
C_b
COM
C_E
R_L 50Ω
F_T
$-V_{EE}$
100Ω 2W

Lᴇ is 10 turns of N 26AWG on ⅛" mandril loose wound.

Cь is Base bypass parallel plate capacitor using 1 mil mylar tape.

Cᴇ is variable capacitor 8-10 pF, Johanson #2950.

FT is Ceramic feed through capacitor, 470 pF, Allen Bradley #FU-60.

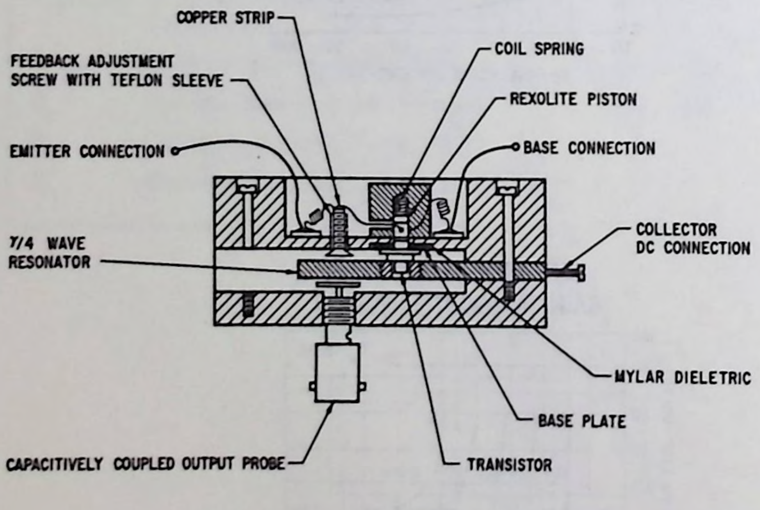
Lʙ is a 72Ω, ½ W carbon resistor, with 1 inch leads.

CR-LCʀ = Effect of ¼ wave resonator.

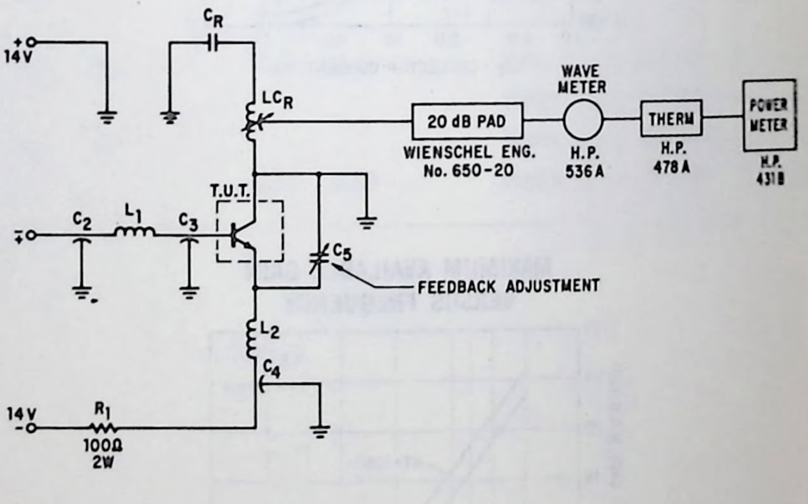
2 GHz OSCILLATOR CAPABILITY

PRODUCT	MIN. P_o	TYP. P_o	CONVERSION EFFICIENCY
MT1050	200 mW	250 mW	10%

2 GHz TEST OSCILLATOR


COPPER STRIP
FEEDBACK ADJUSTMENT SCREW WITH TEFLON SLEEVE
COIL SPRING
REXOLITE PISTON
EMITTER CONNECTION
BASE CONNECTION
COLLECTOR DC CONNECTION
γ/4 WAVE RESONATOR
MYLAR DIELETRIC
BASE PLATE
CAPACITIVELY COUPLED OUTPUT PROBE
TRANSISTOR

2 GHz TEST OSCILLATOR RF GROUNDED BASE


+14V
C_R
LC_R
20 dB PAD
WIENSCHEL ENG. No. 650-20
WAVE METER
H.P. 536A
THERM
H.P. 478A
POWER METER
H.P. 431B
T.U.T.
C_2
L_1
C_3
C_5
FEEDBACK ADJUSTMENT
L_2
C_4
14V
R_1
100Ω 2W

C_2-C_4 = 470 pF, Allen Bradley #FU60, ceramic feed thru capacitors paralleled with 500 pF uncapsulated ceramic disc capacitors.
C_3 = Base bypass capacitor (parallel plate capacitor using 1 mil. mylar tape).
C_R-LC_R = Effect of $\gamma/4$ resonator.
C_S = Effect of E to C feedback adjustment screw.
L_1 = 6 turns #28 wire, loose wound ⅛" dia.
R_1 = External current limiting resistor.

MT1060/MT1060A • MT1061/MT1061A • MT1063

NPN MICROWAVE AMPLIFIER OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — These transistors are NPN Silicon planar epitaxial transistor, designed for microwave service. The high gain-bandwidth products plus low $r_b'C_c$ time constants make the MT-1060, MT-1060A useful to 4 GHz while the MT-1061, MT-1061A have maximum frequency of oscillation to 5 GHz. Three packages are offered, the TO-46 outline for low-power oscillator applications, the TO-72 outline for small signal UHF amplifiers and a special package for hybrid integrated circuit use (MT-1063).

- **HIGH GAIN-BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$**
- **HIGH f_{max}**
- **LOW NOISE FIGURE**
- **SPECIAL PACKAGE FOR HYBRID I.C.'s (MT-1063)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

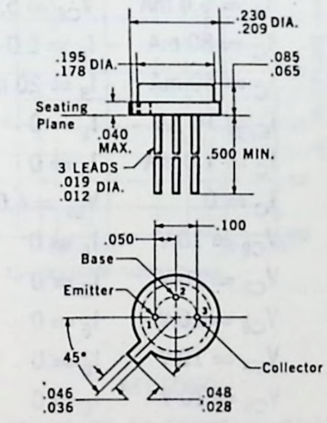
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+175°C

Maximum Power Dissipation (Note 2)	**MT-1060/1060A**	**MT-1061/1061A**	**MT-1063**
Total Dissipation at 25°C Case Temperature	Note 3 1.0 W	Note 4 0.5 W	
at 25°C Ambient Temperature	Note 3 0.3 W	Note 4 0.25 W	Note 5 0.25 W
at 25°C Mounting Surface Temperature			Note 5 0.5 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 6)	14 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	80 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline

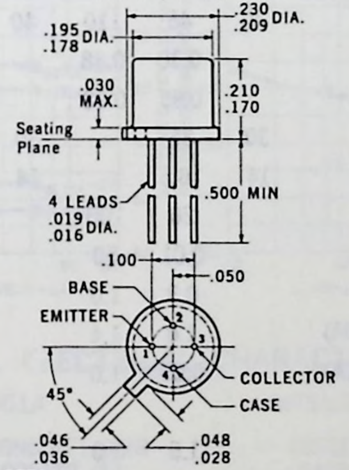

.230 .209 DIA.
.195 .178 DIA.
.085 .065
Seating Plane
.040 MAX.
3 LEADS .019 .012 DIA.
.500 MIN.
.050
.100
Base
Emitter
45°
Collector
.046 .036
.048 .028

NOTES:
All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.35 gram

MT1060 • MT1060A

Notes on page 2

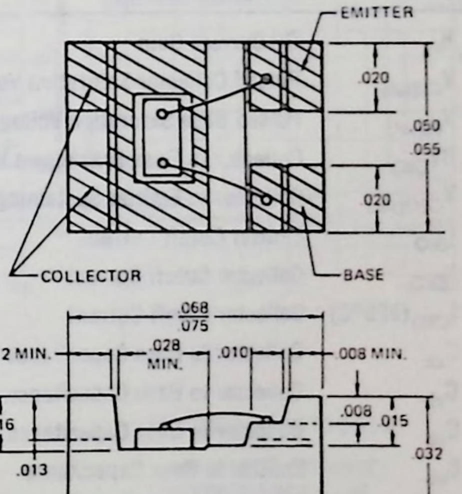
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-72)


.230 .209 DIA.
.195 .178 DIA.
.030 MAX.
.210 .170
Seating Plane
4 LEADS .019 .016 DIA.
.500 MIN
.100
.050
BASE
EMITTER
45°
COLLECTOR
CASE
.046 .036
.048 .028

NOTES:
All dimensions in inches
Leads are gold-plated kovar
All transistor elements isolated from case
Package weight is 0.47 gram

MT1061 • MT1061A

PHYSICAL DIMENSIONS


EMITTER
.020
.050 .055
.020
COLLECTOR
BASE
.068 .075
.012 MIN.
.028 MIN.
.010
.008 MIN.
.016
.013
.008
.015
.032

▧ INDICATES METALIZATION
The transistor is protected by epoxy covering

MT1063

*Planar is a patented Fairchild process.

FAIRCHILD SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

FAIRCHILD TRANSISTORS MT1060 • MT1060A • MT1061 • MT1061A • MT1063

HIGH FREQUENCY CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	TYPE	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
f_T	Gain Bandwidth Product	MT-1060A	1.3	1.5		GHz	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1060	1.0	1.3		GHz	f = 500 MHz
		MT-1061A	1.3	1.5		GHz	
		MT-1061	1.0	1.3		GHz	
$r_b'C_c$	Base-Collector Time Constant	MT-1060A		3.5	4.5	ps	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1060		3.5	4.5	ps	f = 79.8 MHz
		MT-1061A		2.5	3.5	ps	
		MT-1061		2.5	3.5	ps	
f_{max}	Maximum Frequency of Oscillation (Note 8)	MT-1060A	3.4	4.2		GHz	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1060	3.0	3.8		GHz	
		MT-1061A	3.8	4.9		GHz	
		MT-1061	3.4	4.6		GHz	
MAG	Maximum Available Gain at f = 1 GHz	MT-1060A		12.8		dB	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1061A		13.8		dB	
MAG	Maximum Available Gain at f = 2 GHz	MT-1060A		6.4		dB	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1061A		7.8		dB	
NF	Noise Figure f = 450 MHz, $R_S = 50\ \Omega$	MT-1061A		2.3	3.0	dB	$V_{CE} \approx 10$ V, $I_E = 1.5$ mA
		MT-1061		2.7	3.5	dB	
G_{pe}	Neutralized Power Gain f = 450 MHz, $R_g = 50\ \Omega$,	MT-1061A	15.0	17.0		dB	$V_{CE} \approx 10$ V, $I_E = 1.5$ mA
	20 MHz BW	MT-1061	12.5	14.5		dB	

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

			MT1060 MT1061			MT1060A MT1061A MT1063				
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	45	110	40	75	185		$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 7)		0.30	0.38		0.25	0.35	Volts	$I_C = 80$ mA	$I_B = 8.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 7)		0.95	0.98		0.93	0.96	Volts	$I_C = 40$ mA	$I_B = 20$ mA
BV_{CBO}	Collector to Base Breakdown Voltage	30	35		30	35		Volts	$I_C = 10\ \mu$A	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 6)	14	16.5		14	16.5		Volts	$I_C = 1.0$ mA	$I_B = 0$
I_{EBO}	Emitter Cutoff Current		20	100		20	100	µA	$I_C = 0$	$V_{EB} = 4.0$ V
I_{CBO}	Collector Cutoff Current		0.01	50		0.01	50	nA	$V_{CB} = 10$ V	$I_E = 0$
I_{CBO}(125°C)	Collector Cutoff Current		0.3	1.0		0.3	1.0	µA	$V_{CB} = 10$ V	$I_E = 0$
C_{cb}	Collector to Base Capacitance (MT1060, MT1060A)		1.0	1.4		1.0	1.4	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{cb}	Collector to Base Capacitance (MT1061, MT1061A)		0.85	1.0		0.85	1.0	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{cb}	Collector to Base Capacitance (MT1063)					1.2	1.33	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{eb}	Emitter to Base Capacitance		1.5	3.0		1.5	3.0	pF	$V_{EB} = +0.5$ V	$I_C = 0$
$\lvert h_{fe} \rvert$	Magnitude of High Frequency Current Gain, f = 500 MHz	2.0	2.6		2.6	3.0			$V_{CE} = 10$ V	$I_C = 20$ mA

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.7 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2 mW/°C).

(4) These ratings give a maximum junction temperature of 175°C and a junction to case thermal resistance of 300°C/Watt (derating factor of 3.33 mW/°C); junction to ambient thermal resistance of 600°C/Watt (derating factor of 1.67 mW/°C).

(5) These ratings give a maximum junction temperature of 175°C and a junction to ambient resistance of 600°C/Watt (derating factor of 1.67 mW/°C); junction to mounting surface of 300°C/Watt (derating factor of 3.33 mW/°C).

(6) Rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

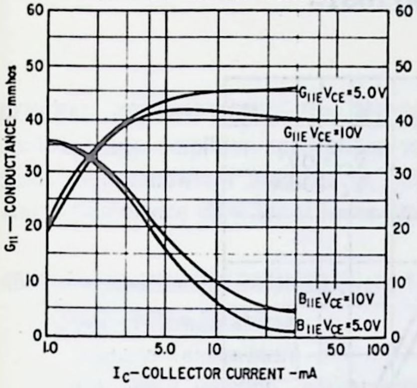
(7) Pulse Conditions: length = 300 µs; duty cycle = 1.0%.

(8) Calculated from: $f_{max} = \sqrt{\dfrac{f_T}{8\pi r_b'C_c}}$

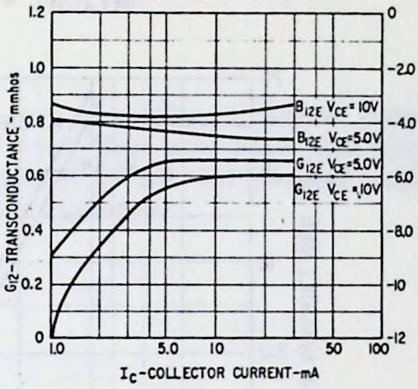
TYPICAL COMMON EMITTER "Y" PARAMETERS VERSUS COLLECTOR CURRENT

MT1060 • MT1060A (f = 500 MHz)

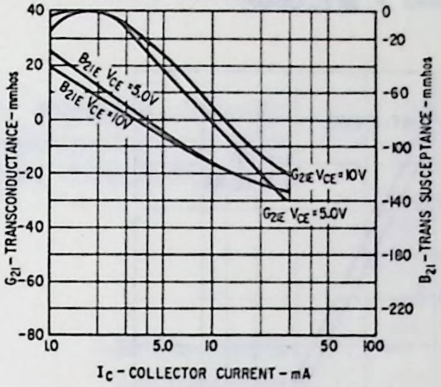
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



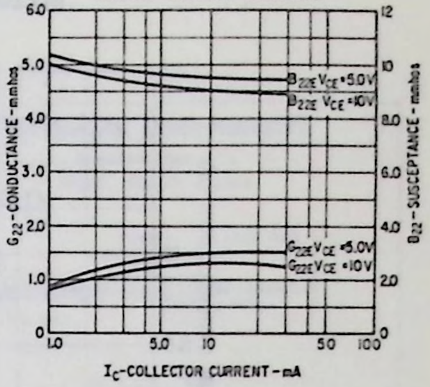
Y_{12E}, REVERSE TRANSADMITTANCE, INPUT SHORT CIRCUIT



Y_{21E}, FORWARD TRANSADMITTANCE, OUTPUT SHORT CIRCUIT

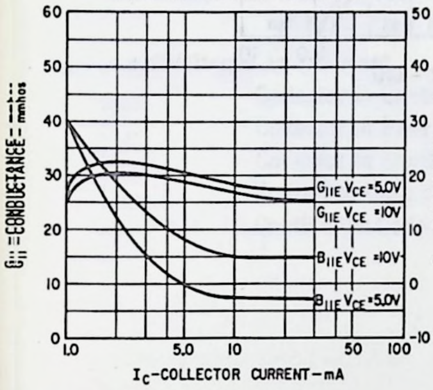


Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT

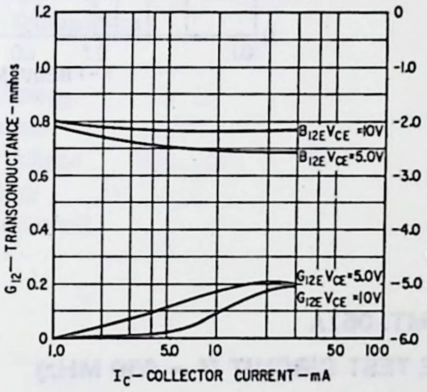


MT1061 • MT1061A (f = 500 MHz)

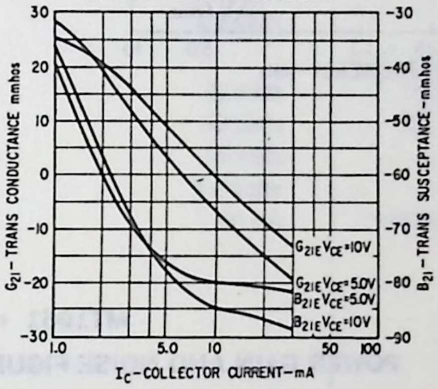
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



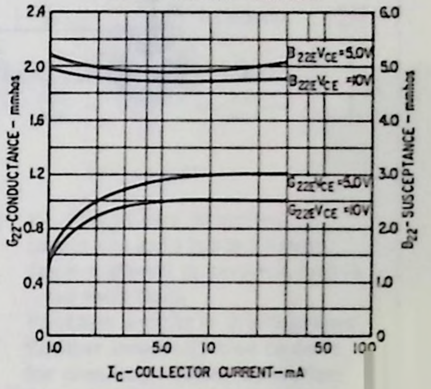
Y_{12E}, REVERSE TRANSADMITTANCE, INPUT SHORT CIRCUIT



Y_{21E}, FORWARD TRANSADMITTANCE, OUTPUT SHORT CIRCUIT

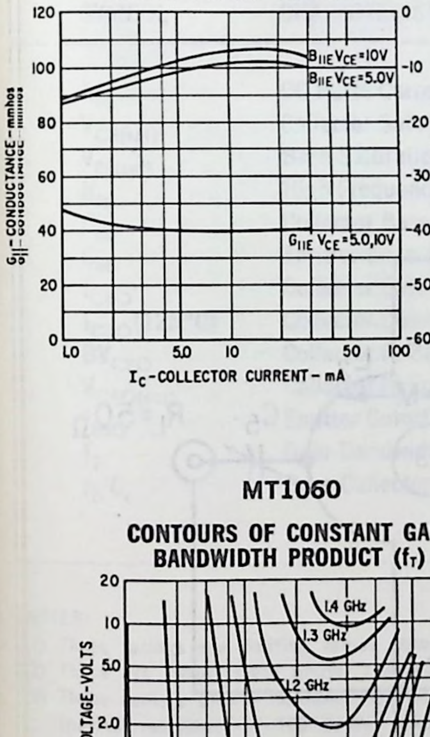


Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT

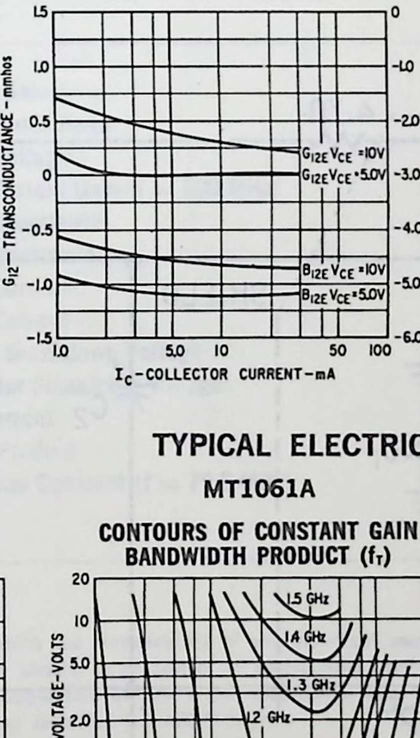


MT1061 • MT1061A (f = 1.0 GHz)

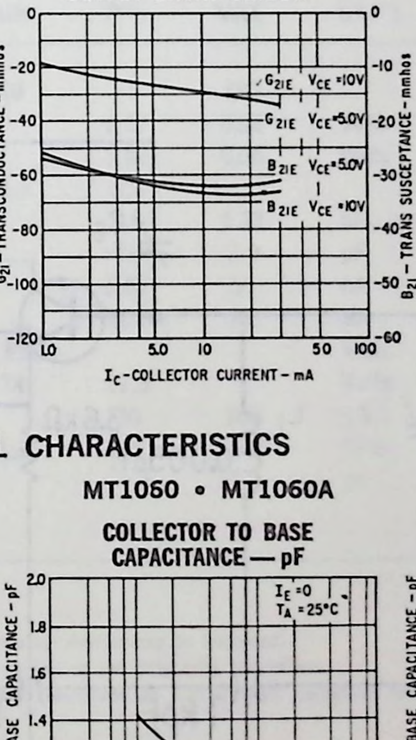
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



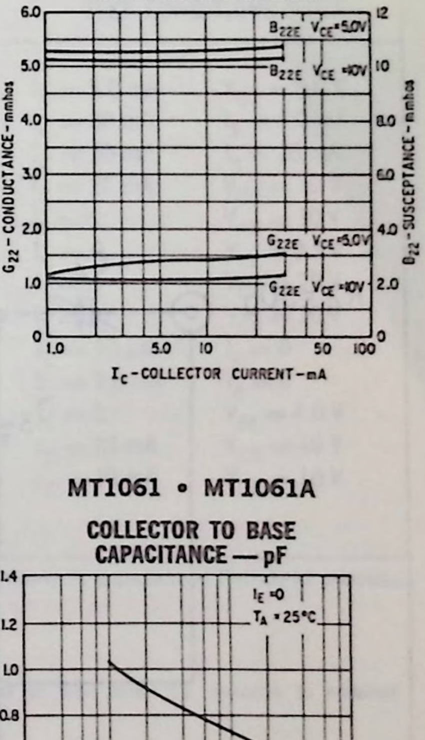
Y_{12E}, REVERSE TRANSADMITTANCE, INPUT SHORT CIRCUIT



Y_{21E}, FORWARD TRANSADMITTANCE, OUTPUT SHORT CIRCUIT



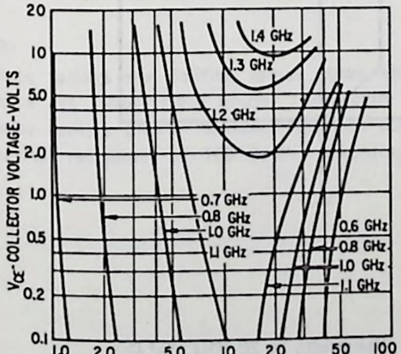
Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT



TYPICAL ELECTRICAL CHARACTERISTICS

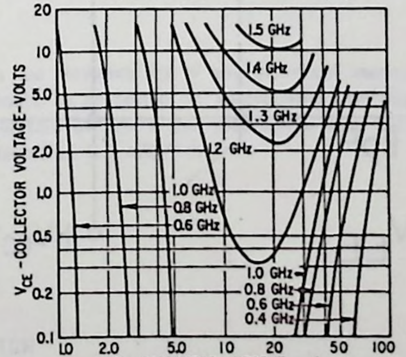
MT1060

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



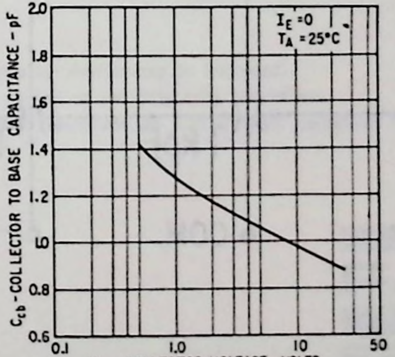
MT1061A

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



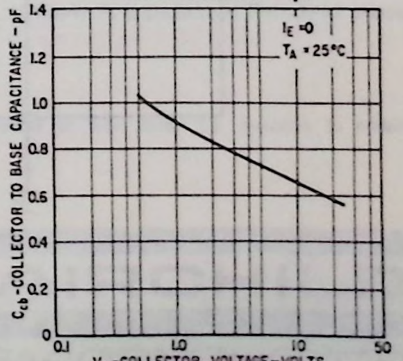
MT1060 • MT1060A

COLLECTOR TO BASE CAPACITANCE — pF



MT1061 • MT1061A

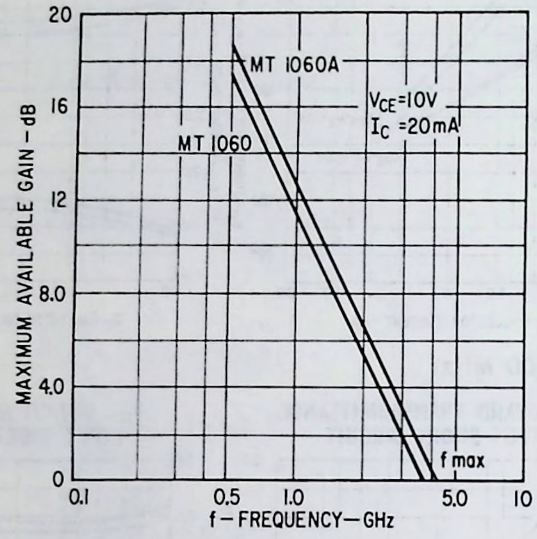
COLLECTOR TO BASE CAPACITANCE — pF



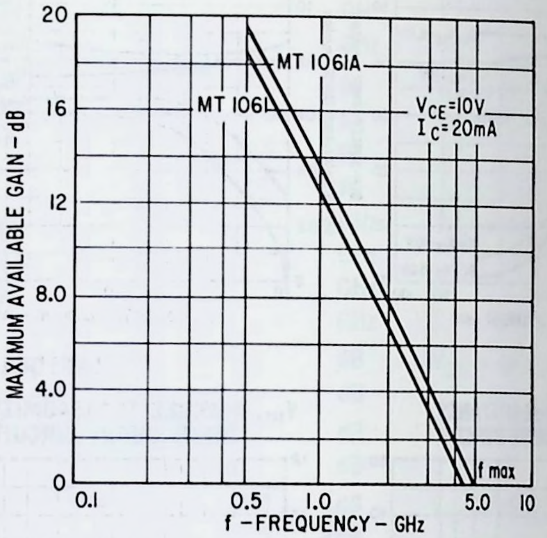
AMPLIFIER CHARACTERISTICS

MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY

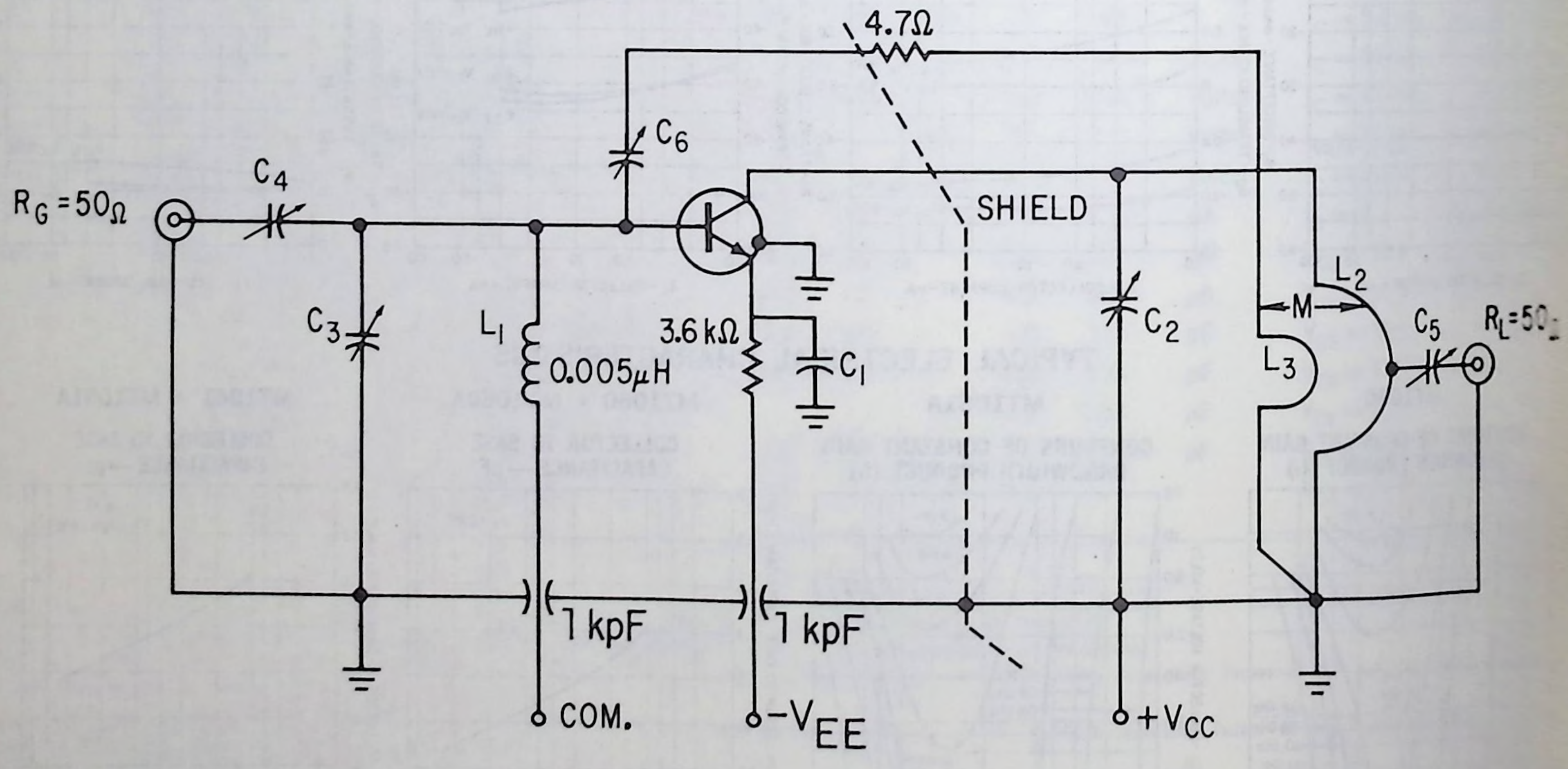
MT1060 • MT1060A



MT1061 • MT1061A



MT1061 • MT1061A
POWER GAIN AND NOISE FIGURE TEST CIRCUIT (f = 450 MHz)


4.7Ω
C_6
C_4
R_G =50Ω
SHIELD
C_3
L_1
0.005μH
3.6 kΩ
C_1
C_2
M
L_2
L_3
C_5
R_L=50Ω
1 kpF
1 kpF
COM.
–V_{EE}
+V_{CC}

NOTE: Bandwidth ≥ 20 MHz (Set C_5)
C_1—Uncapsulated Disc Ceramic Capacitor > 500 pF
C_2, C_3, C_4, C_5, C_6 = 0.8—10 pF
L_2 IT #22 tinned wire ½" dia. tap ¾ up from ground
L_3 IT #22 tinned wire 5/16" dia.

MT1062

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPE

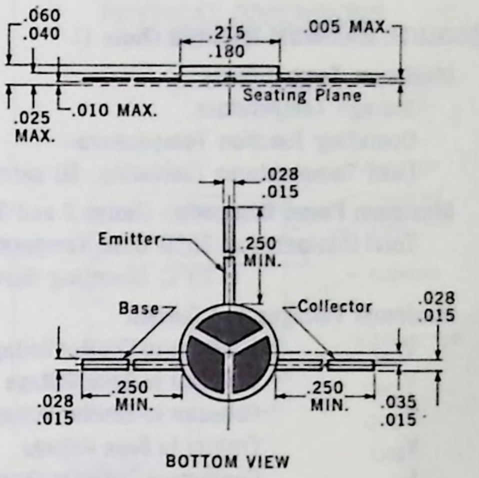
SILICON PLANAR* EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION — The MT1062 is a Silicon Planar* Epitaxial Transistor intended for Microwave oscillator and amplifier applications to 3.5 GHz. These units feature good high-frequency current gain which yields gain-bandwidth products (f_T) of typically 1.5 GHz. Co-Planer lead construction of the TO-50 package makes this device ideal for stripline amplifier applications.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	175°C Maximum
Lead Temperature (Soldering, 60 second time limit)	300°C Maximum
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	1.0 Watt
at 25°C Free Air Temperature	0.3 Watt
Maximum Voltages and Current	
V_{CES} Collector to Emitter Voltage	30 Volts
V_{CBO} Collector to Base Voltage	30 Volts
V_{CEO} Collector to Emitter Voltage	14 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts
I_C Continuous Collector Current	80 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-50) outline



NOTES: All dimensions in inches
Leads are gold plated Kovar
Base material is ceramic and is 10 mils thick
Package weight is 0.126 grams
Emitter internally tied to case for common emitter operation

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain	40	75	185		$I_C = 5.0$ m $_{CE} = 5.0$
$V_{CE(sat)}$	Collector Saturation Voltage		0.27	0.35	Volts	$I_C = 80$ m = 8.0 m
$V_{BE(sat)}$	Base Saturation Voltage		0.93	0.96	Volts	$I_C = 40$ = 20 m
h_{fe}	High Frequency Current Gain (f = 500 MHz)	2.6	3.0			$I_C = 20$ = 10
C_{cb}	Collector Base Capacitance		1.0	1.33	pF	$I_E = 0$
C_{eb}	Emitter Base Capacitance		2.0	3.0	pF	$I_C = 0$
I_{CBO}	Collector Cutoff Current		0.01	50	nA	$I_E = 0$
I_{CBO}(125°C)	Collector Cutoff Current		0.3	1.0	μA	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 1$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	14	17.5		Volts	$I_C = 1.$
I_{EBO}	Emitter Cutoff Current		20	100	μA	$I_C = 0$
f_T	Gain-Bandwidth Product	1.3	1.5		GHz	$I_C = 20$
$r_b'C_c$	Base Collector Time Constant (f = 79.8 MHz)			3.5	ps	$I_C = 20$ = 10 V

*Planar is a pat irchild process.

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

MT1070

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPE

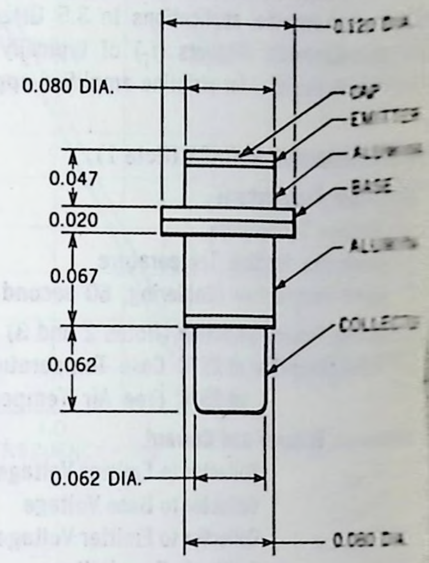
SILICON PLANAR* EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION — The MT1070 is a Silicon Planar* Epitaxial Transistor featuring a coaxial package that provides very low inter-electrode capacitance, very low lead inductance and high emitter-to-collector isolation. This device is ideally suited for small signal amplifier and oscillator applications to 3.5 GHz.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		175°C
Lead Temperatures (Soldering, 60 second time limit)		300°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature		1.5 W
at 25°C Mounting Surface Temperature		1.0 W
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage	14 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	80 mA

PHYSICAL DIMENSIONS



NOTES:
All dimensions in inches
Emitter and base connections are gold-plated KOVAR
Collector is internally connected to copper

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain	40	45	185		$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage (Pulsed)		0.27	0.35	Volts	$I_C = 80$ mA	$I_B = 8.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Pulsed)		0.93	0.96	Volts	$I_C = 40$ mA	$I_B = 20$ mA
h_{fe}	High Frequency Current Gain (f = 500 MHz)	2.6	3.0			$I_C = 20$ mA	$V_{CE} = 10$ V
C_{cb}	Collector Base Capacitance		0.90	1.0	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter Base Capacitance		2.0	3.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		0.01	50	nA	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}(125°C)	Collector Cutoff Current		0.3	1.0	μA	$I_E = 0$	$V_{CB} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 10$ μA	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	14	17.5		Volts	$I_C = 1.0$ mA	$I_B = 0$
I_{EBO}	Emitter Cutoff Current		20	100	μA	$I_C = 0$	$V_{EB} = 4.0$ V
F_T	Gain-Bandwidth Product	1.3	1.5		GHz	$I_C = 20$ mA	$V_{CE} = 10$ V
$r_b'C_c$	Base Collector Time Constant (f = 79.8 MHz)			2.5	ps	$I_C = 20$ mA	$V_{CE} = 10$ V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to mounting surface of 500°C/Watt (derating factor of 2.0 mW/°C).

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

MT1115 • MT1116

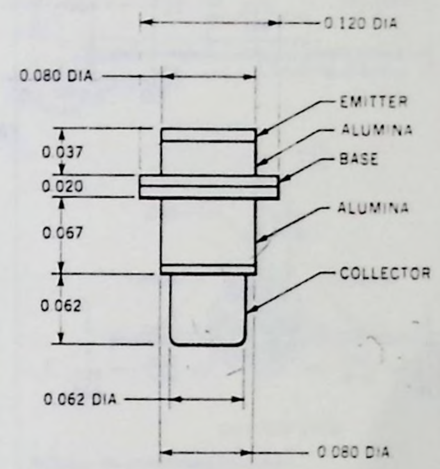
NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — The MT-1115 and MT-1116 are NPN planar epitaxial transistors designed for S-band and C-band oscillator applications. These transistors are tested to guarantee 90 mW minimum of output power for MT-1116, and 45 mW for MT-1115 while operating at about 20% efficiency.

- **GUARANTEED MINIMUM OSCILLATOR POWER OUT AT 3.0 GHz**
- **HIGH GAIN BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$ . . . 2.5 ps MAX**
- **HIGH f_{max} . . . . TYP. OF 8.0 GHz FOR MT-1116**
- **COAXIAL STRUCTURE**

PHYSICAL DIMENSIONS



NOTES:
All dimensions in inches
Emitter and base connections are gold-plated KOVAR
Collector is internally connected to copper stud

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+175°C
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	1.0 Watt
at 25°C Ambient Temperature	0.2 Watt
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	28 Volts
V_{CES} Collector to Emitter Voltage	28 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	12 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts
I_C Continuous Collector Current	80 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		MT-1115			MT-1116					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	45	155	20	45	155		$I_C = 500\ \mu A$	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.27	0.38		0.27	0.38	Volts	$I_C = 80$ mA	$I_B = 8$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.93	0.98		0.93	0.98	Volts	$I_C = 40$ mA	$I_B = 20$ mA
h_{fe}	High Frequency Current Gain (f = 500 MHz)	3.0	3.6		3.0	4.0			$I_C = 20$ mA	$V_{CE} = 10$ V
C_{cb}	Collector to Base Capacitance		0.7	0.8		0.7	0.8	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{eb}	Emitter to Base Capacitance		1.7	2.0		1.7	2.0	pF	$V_{EB} = +0.5$ V	$I_C = 0$
I_{CBO}	Collector Cutoff Current		0.01	10		0.01	10	nA	$V_{CB} = 10$ V	$I_E = 0$
I_{CBO}(150°C)	Collector Cutoff Current		10	50		10	50	nA	$V_{CB} = 10$ V	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	28	32		28	32		Volts	$I_C = 10\ \mu A$	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 4)	12	15		12	15		Volts	$I_C = 1.0$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	4.75		4.0	4.75		Volts	$I_E = 100\ \mu A$	$I_C = 0$
P_o	Oscillator Power Out (f = 3.0 GHz)				90	100		mW	$V_{CB} = 12$ V	$I_C \leq 45$ mA
P_o	Oscillator Power Out (f = 3.0 GHz)	45	60					mW	$V_{CB} = 12$ V	$I_C \leq 50$ mA
$r_b'C_c$	Collector to Base Time Constant (f = 79.8 MHz)		2.0	2.5		1.5	2.5	ps	$I_C = 20$ mA	$V_{CB} = 10$ V

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to ambient thermal resistance of 750°C/Watt (derating factor of 1.33 mW/°C).
(4) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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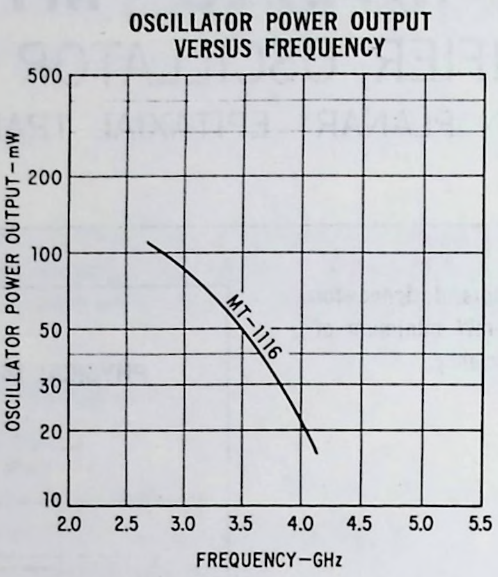
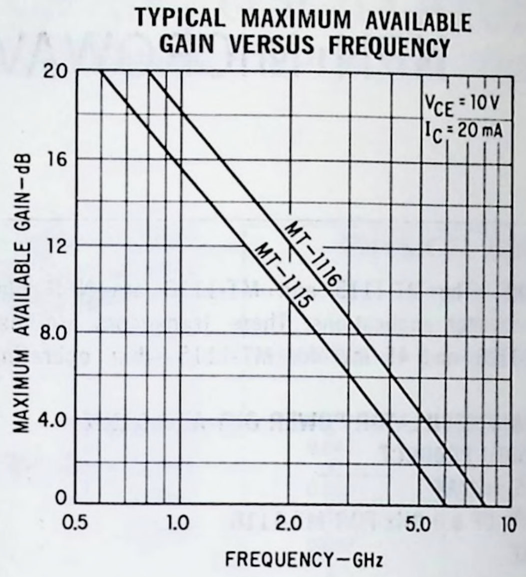
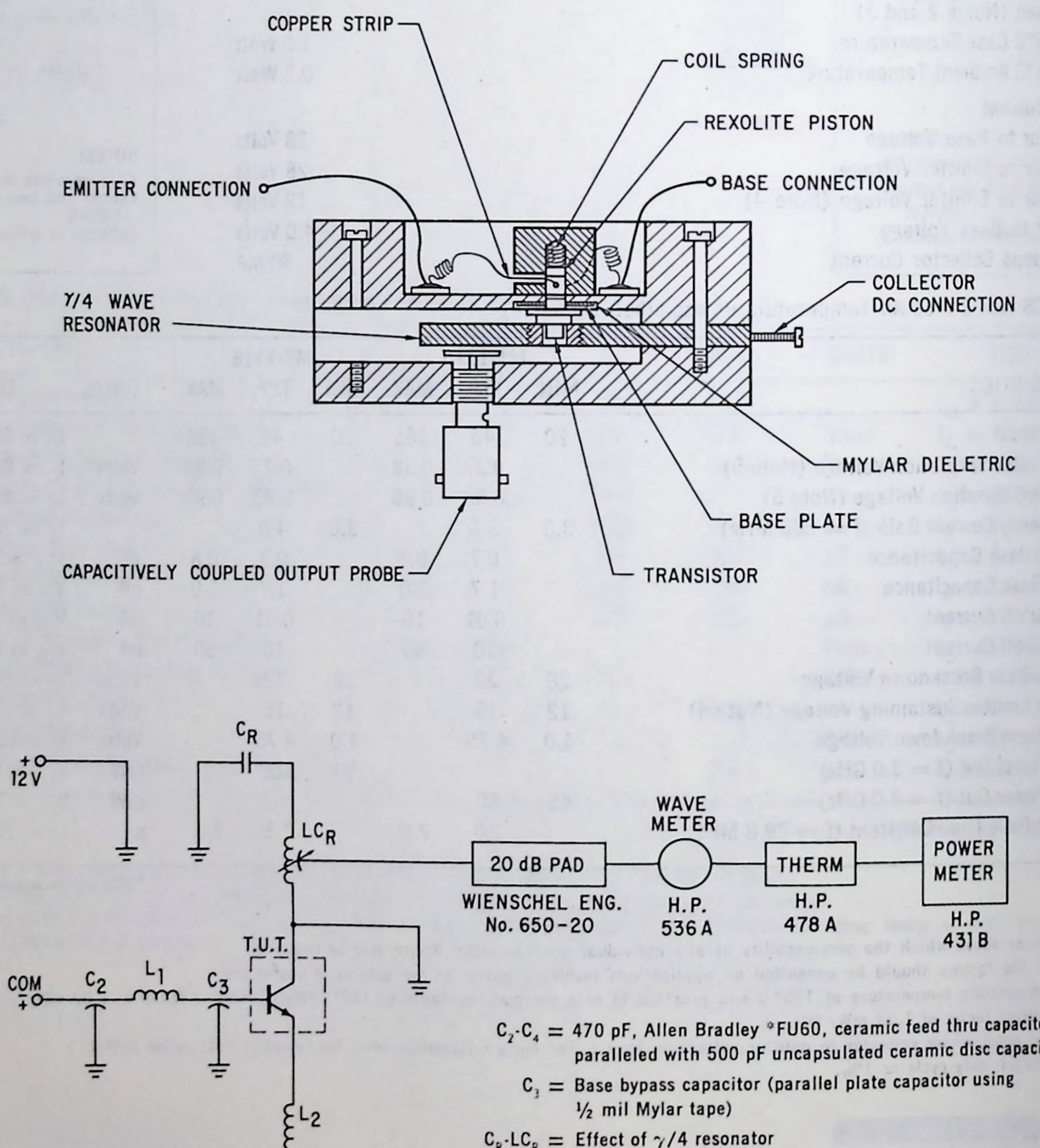




3.0 GHz TEST CIRCUIT


COPPER STRIP
COIL SPRING
REXOLITE PISTON
EMITTER CONNECTION
BASE CONNECTION
COLLECTOR DC CONNECTION
γ/4 WAVE RESONATOR
MYLAR DIELETRIC
BASE PLATE
CAPACITIVELY COUPLED OUTPUT PROBE
TRANSISTOR
+12 V
C_R
LC_R
20 dB PAD
WIENSCHEL ENG. No. 650-20
WAVE METER
H.P. 536 A
THERM
H.P. 478 A
POWER METER
H.P. 431 B
T.U.T.
COM
C_2
L_1
C_3
L_2
C_4
V_{EE}
R_1
100Ω
2W

C_2-C_4 = 470 pF, Allen Bradley *FU60, ceramic feed thru capacitors paralleled with 500 pF uncapsulated ceramic disc capacitors

C_3 = Base bypass capacitor (parallel plate capacitor using ½ mil Mylar tape)

C_R-LC_R = Effect of γ/4 resonator

L_1 = 6 turns #28 wire, loose wound ⅛" dia.

R_1 = External current limiting resistor

MT3833 • MT3834

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — The MT3833 and MT3834 are Silicon Planar Epitaxial Transistors intended for microwave oscillator and amplifier applications. These units feature good high frequency current gain plus low $r_b'C_c$ time constants making the MT3833 usable to 5.0 GHz, and the MT3834 usable to 4.5 GHz. Co-Planar lead construction of the TO-50 package makes these devices ideal for stripline oscillator and amplifier applications.

FEATURES:

- **HIGH GAIN-BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$**
- **HIGH f_{max}**
- **CO-PLANAR PACKAGE**
- **GUARANTEED OSCILLATOR POWER AT 2.0 GHz**

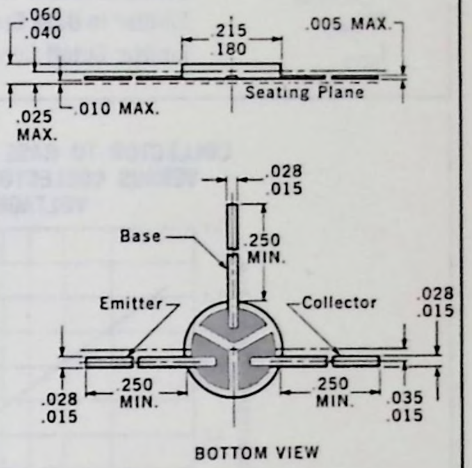
ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+175°C
Lead Temperature (Soldering, 60 second time limit)	+300°C
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	1.0 Watt
at 25°C Free Air Temperature	0.3 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	100 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-50) outline



NOTES: All dimensions in inches
Leads are gold plated Kovar
Base material is ceramic and is 10 mils thick
Package weight is 0.126 grams
Base internally tied to case
for common base operation

HIGH FREQUENCY CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MT3833 MIN.	MT3833 TYP.	MT3833 MAX.	MT3834 MIN.	MT3834 TYP.	MT3834 MAX.	UNITS	TEST CONDITIONS	
f_T	Gain Bandwidth Product	1.0	1.5		1.0	1.3		GHz	$I_C = 30$ mA $f = 500$ MHz	$V_{CE} = 12$ V
$r_b'C_c$	Base Collector Time Constant		2.5	3.5		2.7	3.5	ps	$I_C = 30$ mA $f = 79.8$ MHz	$V_{CB} = 12$ V
f_{max}	Maximum Frequency of Oscillation (Note 6)		5.0			4.5		GHz	$I_C = 30$ mA	$V_{CC} = 12$ V
P_o	Oscillator Power Out (See test circuit)	100	120		75	90		mW	$I_C = 30$ mA $f = 2.0$ GHz	$V_{CB} = 12$ V
MAG	Maximum Available Gain		8.0			7.0		dB	$I_C = 30$ mA $f = 2.0$ GHz	$V_{CC} = 12$ V

Additional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications inolving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) Calculated from: $f_{max} = \sqrt{\dfrac{f_T}{8\pi r_b'C_c}}$

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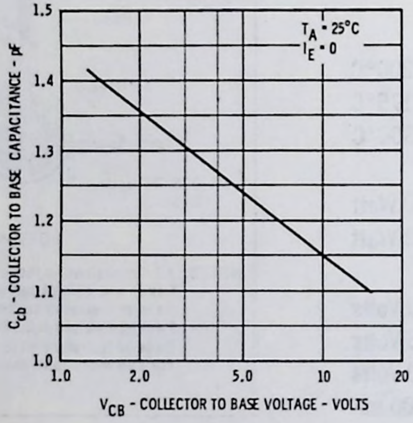
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

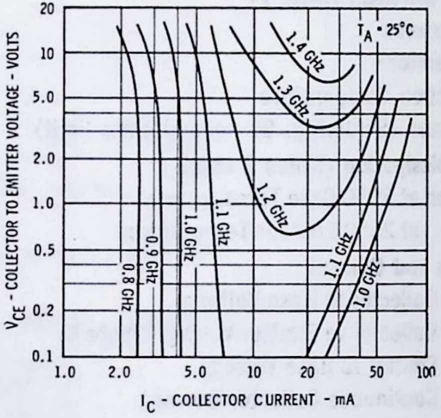
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

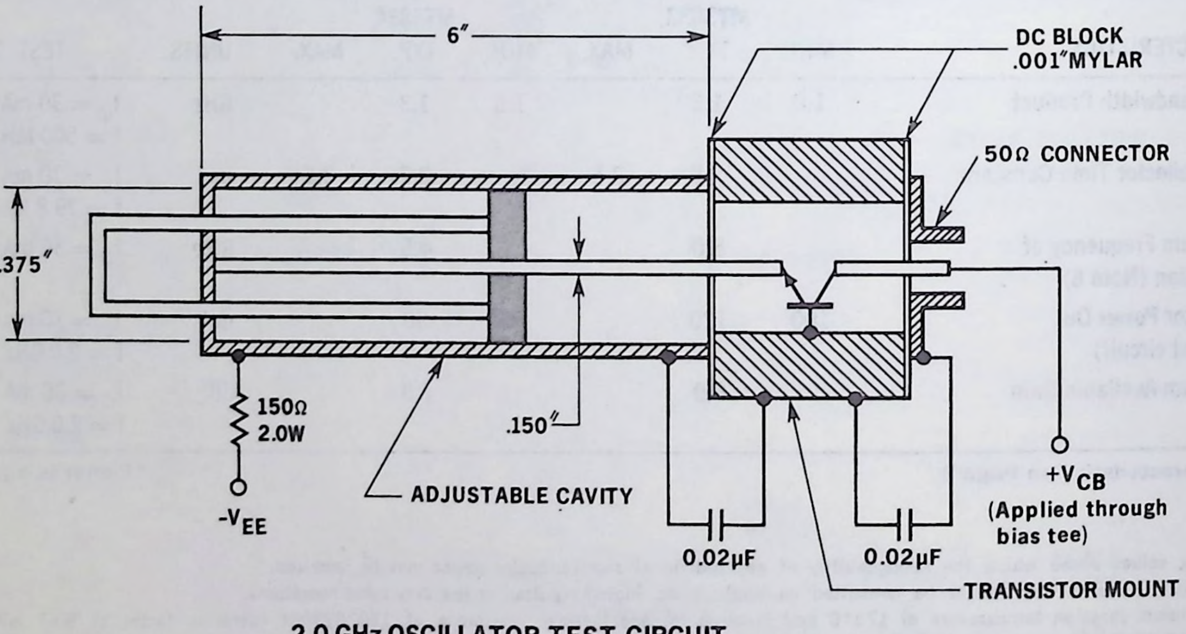
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	20	40			30 mA	$V_{CE} = 12\,V$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.34	0.38	Volts	80 mA	$I_B = 8.0\,mA$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.94	0.98	Vol	40 mA	$I_B = 20\,mA$
h_{fe}	High Frequency Current Gain (f = 500 MHz)	2.0				30 mA	$V_{CE} = 12\,V$
C_{cb}	Collector to Base Capacitance		1.1	1.33	p		$V_{CB} = 12\,V$
C_{eb}	Emitter to Base Capacitance		2.0	3.0	p		$V_{EB} = 0.5\,V$
I_{CES}	Collector Cutoff Current			20			$V_{CE} = 12\,V$
$I_{CES}(100°C)$	Collector Cutoff Current			20			$V_{CE} = 12\,V$
BV_{CBO}	Collector to Base Breakdown Voltage	30				A	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15	17.5			= 2.0 mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	5.0			= 100 μA	$I_C = 0$
I_{EBO}	Emitter Cutoff Current			10	μ	$_C = 0$	$V_{EB} = 3.0\,V$

COLLECTOR TO BASE CAPACITANCE VERSUS COLLECTOR TO BASE VOLTAGE



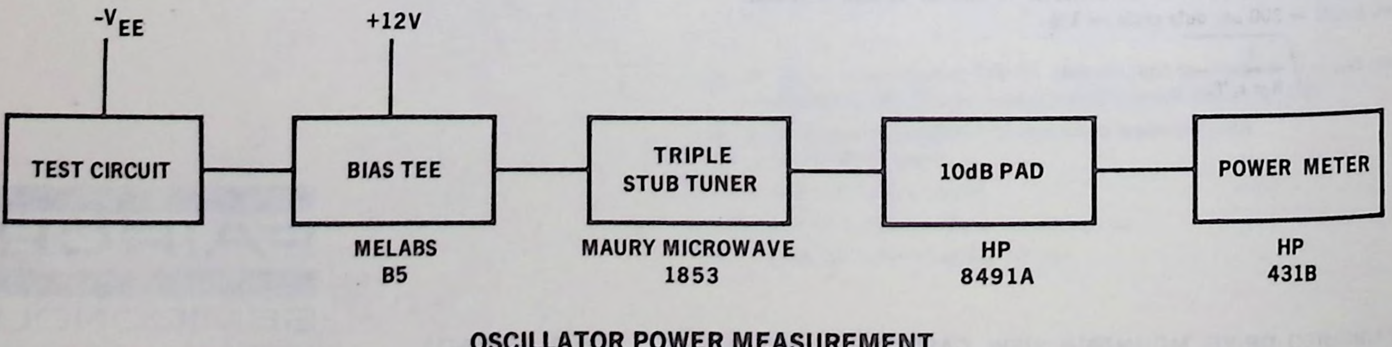
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)





6″
DC BLOCK .001″MYLAR
50Ω CONNECTOR
.375″
.150″
150Ω 2.0W
$-V_{EE}$
ADJUSTABLE CAVITY
0.02μF
0.02μF
$+V_{CB}$ (Applied through bias tee)
TRANSISTOR MOUNT

2.0 GHz OSCILLATOR TEST CIRCUIT



$-V_{EE}$
+12V
TEST CIRCUIT
BIAS TEE
TRIPLE STUB TUNER
10dB PAD
POWER METER
MELABS B5
MAURY MICROWAVE 1853
HP 8491A
HP 431B

OSCILLATOR POWER MEASUREMENT

RF Power Transistors

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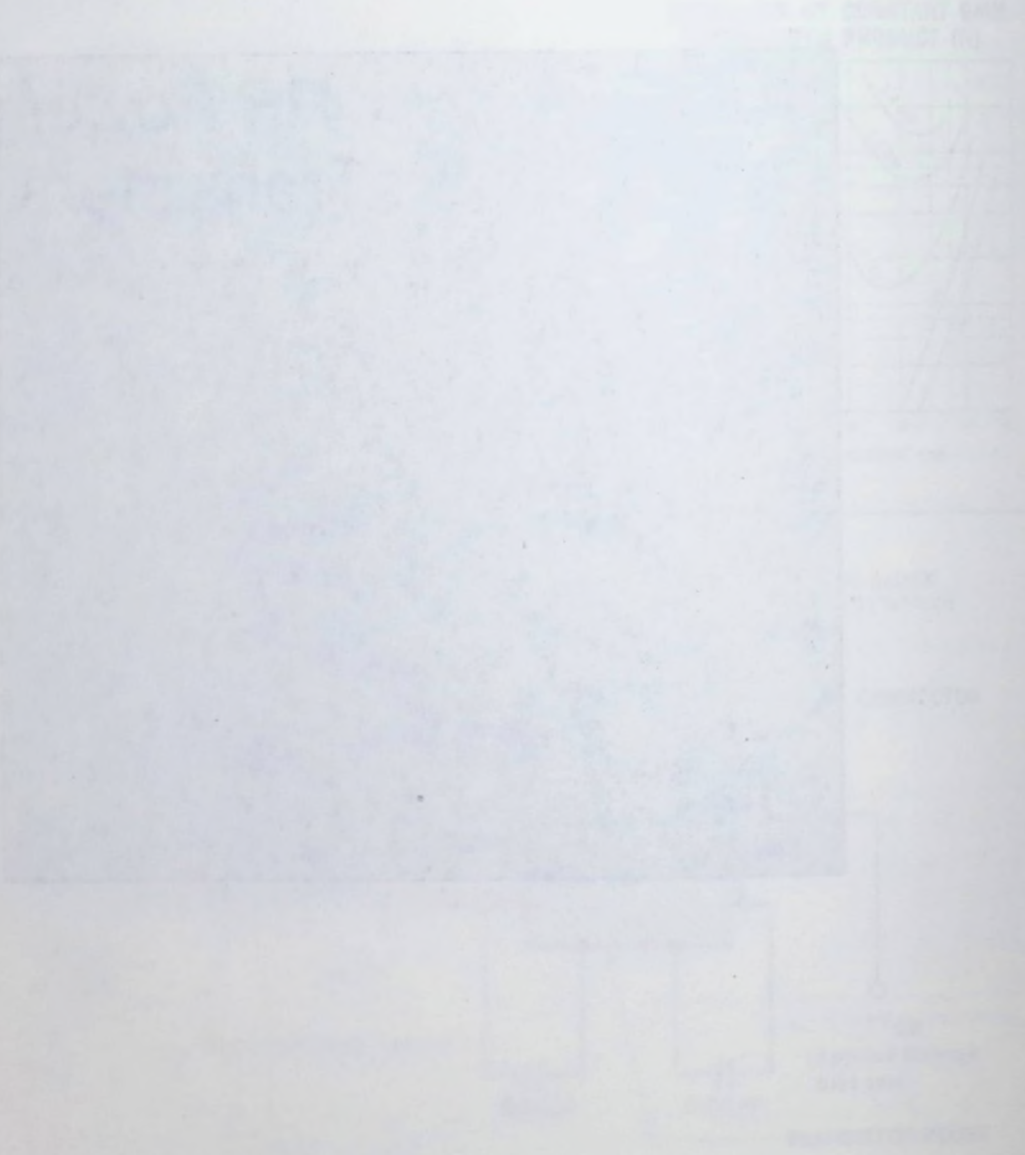

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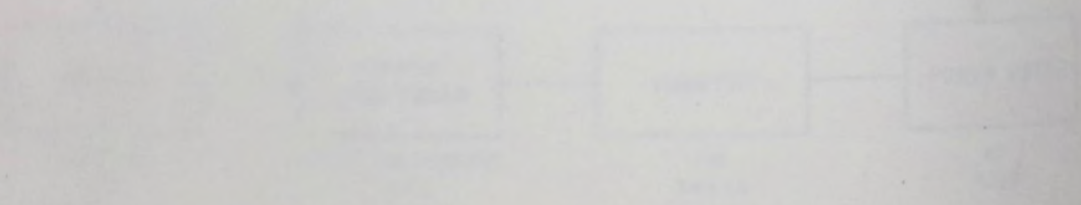

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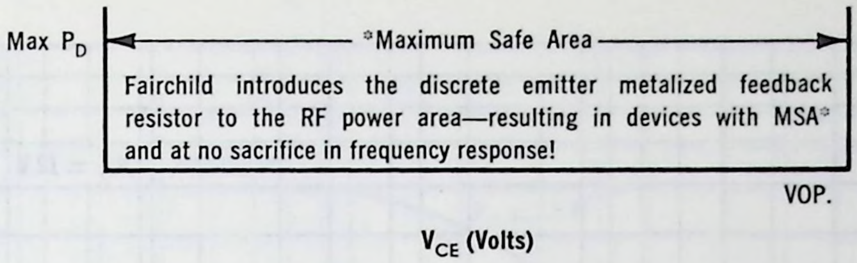
RF POWER TRANSISTOR OPERATIONAL ADVANTAGES



Fairchild introduces the discrete emitter metalized feedback resistor to the RF power area—resulting in devices with MSA* and at no sacrifice in frequency response!

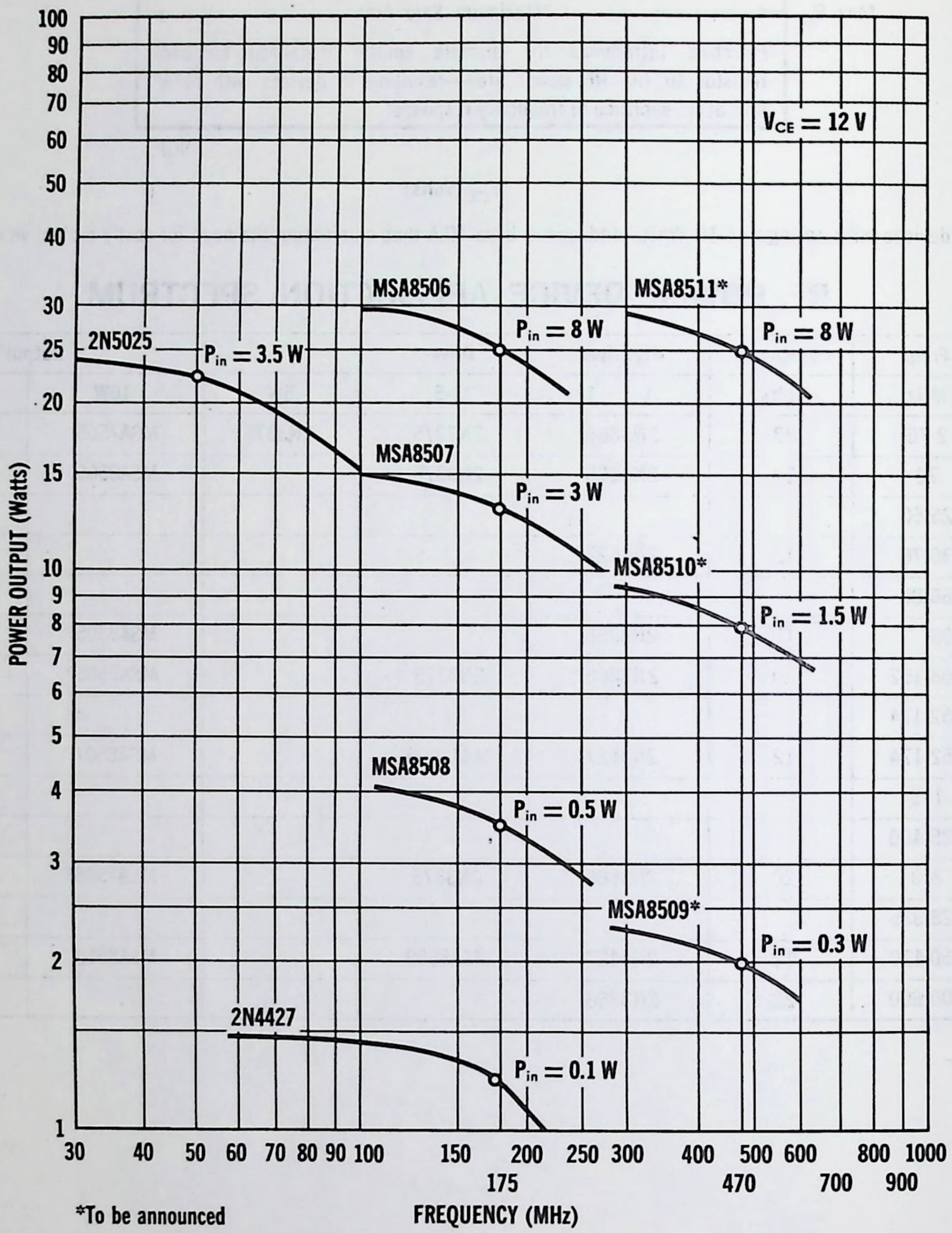
All Fairchild RF Power devices with ratings of 10 Watts and above have MSA thus eliminating the need for costly protective circuitry.

RF POWER DEVICE APPLICATION SPECTRUM

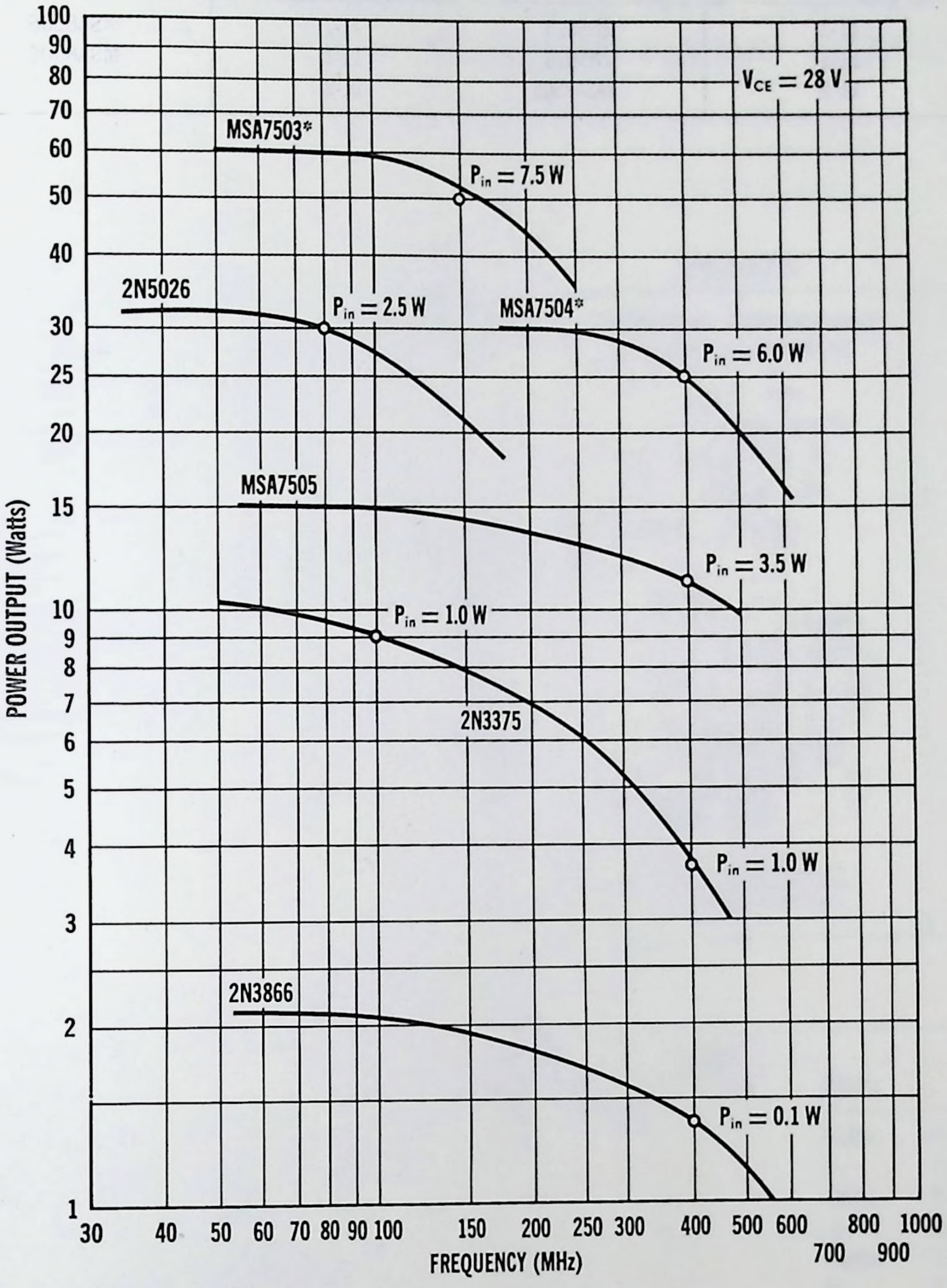
	Freq.	Voltage	Predriver	Driver	Output*			
Application	MHz	Volts	.1 1	3-5	5W	10W	25W	50W
Military FM/SSB	2-76	28	2N3866	2N3375	2N3375	MSA7505	2N5026	MSA7503
RC Model Air-AM*	72	12	2N3866	2N3375		MSA8505		MSA8503*
LO Band Mobile FM	25-50							
HAM SSB*	30-76	12	2N4427				2N5025	
Overseas Mobile FM	66-88							
Private Air. AM*	108-	12	2N3866			MSA8505*		MSA8503*
Military Air. AM*	108-152	20	2N3866	2N3375		MSA7505*		MSA7503*
VHF Mobile FM	152-174							
Port & Marine FM	152-174	12	2N4427	MSA8508		MSA8507	MSA8506	
Sonobouy FM	175							
Military AM*	225-400							
Radio Beacons AM*	243	20	2N3866	2N3375		MSA7505*	MSA7504*	
Aeroglide	328-335							
Portable & CB FM	450-470	12	2N4427	MSA8509		MSA8510	MSA8511	
Fuse Osc.	400-600	28	2N3866					

*CW Power $\frac{\text{Power Output}}{4}$

RF POWER TRANSISTORS



*To be announced



*To be announced

RF POWER TRANSISTOR NUMERICAL INDEX

Type	Page No.	Type	Page No.	Type	Page No.
2N3375	11-1	2N5025	11-7	MSA8505	11-9
2N3553	11-1	2N5026	11-7	MSA8506	11-13
2N3866	11-5	MSA7505	11-9		

2N3375 • 2N3553

NPN LARGE SIGNAL UHF POWER AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION—The 2N3375 and 2N3553 are NPN diffused silicon Planar* epitaxial transistors designed primarily for use in large signal VHF and UHF power amplifier output stages.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C	
Operating Case Temperature	−65°C to +200°C	
Maximum Power Dissipation (Notes 2 and 3)	**2N3375**	**2N3553**
Total Dissipation at 25°C Case Temperature	11.6 Watts	7.0 Watts

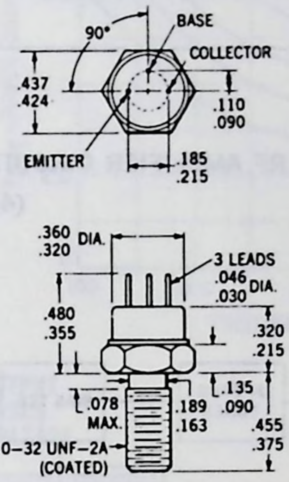
Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	65 Volts	65 Volts
V_{CEO}	Collector to Emitter Voltage	40 Volts	40 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts	4.0 Volts
I_C	Collector Current	1.5 Amps	1.0 Amps

2N3375

PHYSICAL DIMENSIONS

In accordance with JEDEC (TO-60)

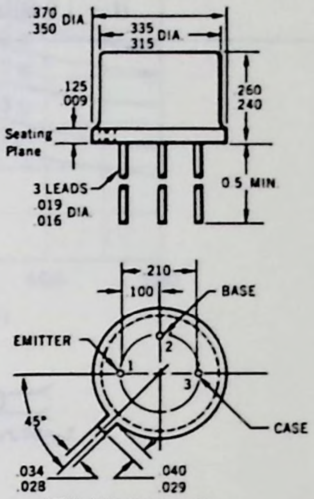


NOTES: All dimensions in inches
Leads are nickel-plated kovar
All leads are isolated from case
Package weight is 4.8 grams

2N3553

PHYSICAL DIMENSIONS

in accordance with
JEDEC (TO-39) outline



NOTES All dimensions in inches
Leads are gold plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N3375 MIN.	2N3375 MAX.	2N3553 MIN.	2N3553 MAX.	UNITS	TEST CONDITIONS	
P_{out}	RF Power Output (f = 400 MHz, Fig. 1)	3.0				Watts	$V_{CE} = 28$ V	$P_{IN} = 1.0$ W
η	Collector Efficiency (f = 400 MHz, Fig. 1)	40				%	$V_{CE} = 28$ V	$P_{IN} = 1.0$ W
P_{out}	RF Power Output (f = 175 MHz, Fig. 2)			2.5		Watts	$V_{CE} = 28$ V	$P_{IN} = 0.25$ W
η	Collector Efficiency (f = 175 MHz, Fig. 2)			50		%	$V_{CE} = 28$ V	$P_{IN} = 0.25$ W
P_{out}	RF Power Output (f = 100 MHz, Fig. 2)	7.5				Watts	$V_{CE} = 28$ V	$P_{IN} = 1.0$ W
η	Collector Efficiency (f = 100 MHz, Fig. 2)	65				%	$V_{CE} = 28$ V	$P_{IN} = 1.0$ W
h_{FE}	DC Pulse Current Gain (Note 4)	10	100	10	100		$I_C = 250$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain (Note 4)		200		200		$I_C = 125$ mA	$V_{CE} = 5.0$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	4.0		4.0			$I_C = 125$ mA	$V_{CE} = 28$ V

Additional Electrical Characteristics on page 2

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 15°C/Watt (derating factor of 66 mW/°C) for the 2N3375 and Watt (derating factor of 40 mW/°C) for the 2N3553.
(4) Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.
(5) Pulsed through a 25 mH Inductor.

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ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N3375		2N3553				
SYMBOL	CHARACTERISTICS	MIN.	MAX.	MIN.	MAX.	UNITS	TEST CONDITIONS	
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 4)		1.0		1.0	Volts	$I_C = 250$ mA	$I_B = 50$ mA
V_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Note 5)	40		40		Volts	$I_C = 200$ mA	$I_B = 0$
V_{CER}(sust)	Collector to Emitter Sustaining Voltage (Note 5)	40		40		Volts	$I_C = 200$ mA	$R_{BE} = 100\ \Omega$
I_{CEO}	Collector Cutoff Current		0.1		0.1	mA	$V_{CE} = 30$ V	$I_B = 0$
I_{EBO}	Emitter Cutoff Current		0.1		0.1	mA	$V_{EB} = 4.0$ V	
I_{CEX}	Collector Cutoff Current		1.0		1.0	mA	$V_{CE} = 65$ V	$V_{BE} = -1.5$ V
I_{CEX}(+200°C)	Collector Cutoff Current		5.0		5.0	mA	$V_{CE} = 30$ V	$V_{BE} = -1.5$ V
C_{obo}	Common Base, Open Circuit Output Capacitance (f = 1.0 MHz)		10		10	pF	$V_{CB} = 30$ V	$I_E = 0$

FIGURE 1
RF AMPLIFIER CIRCUIT FOR 2N3375 – POWER-OUTPUT TEST
(400-MHz Operation)

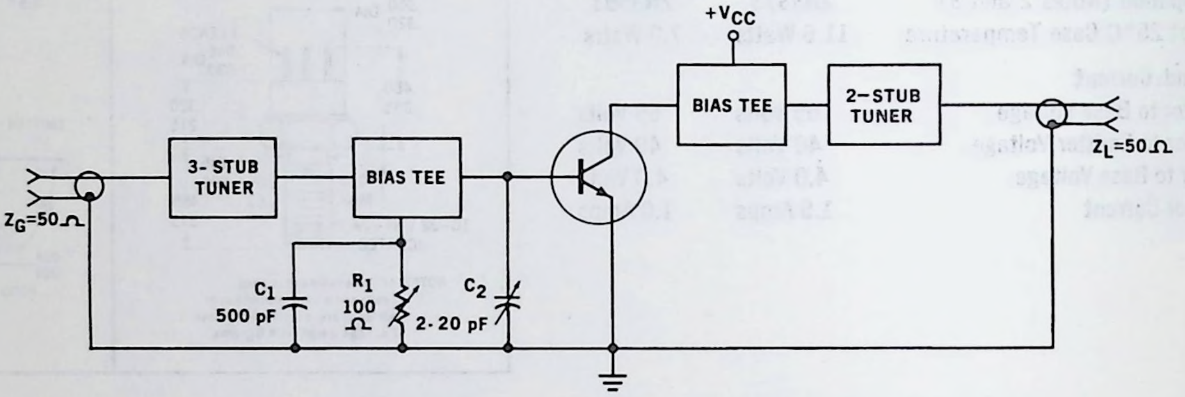
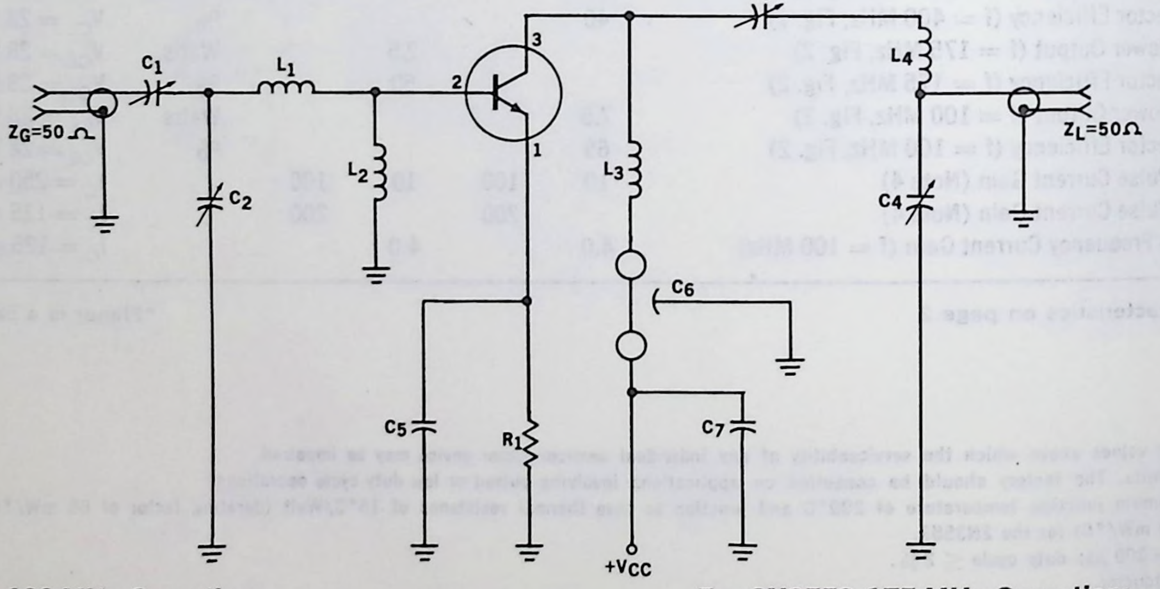


FIGURE 2
RF AMPLIFIER CIRCUIT FOR 2N3375 & 2N3553 – POWER-OUTPUT TEST
(100 & 175-MHz Operation)



For 2N3375 100-MHz Operation:

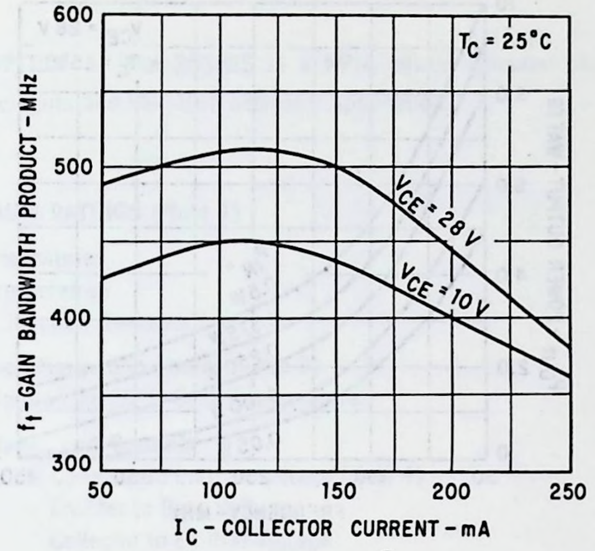
C_1,C_2: 7-100 pF
C_3,C_4: 4-40 pF
C_5: 330 pF, disc ceramic
C_6: 1500 pF
C_7: 0.005 μF, disc ceramic
L_1: 3 turns No. 16 wire, 1/4″ ID, 5/16″ long
L_2: Ferrite choke, Z = 750 (±20%) ohms
L_3: 2.4 μH choke
L_4: 5 turns No. 16 wire, 5/16″ ID, 7/16″ long
R_1: 1.35 ohms, non-inductive

For 2N3553 175-MHz Operation:

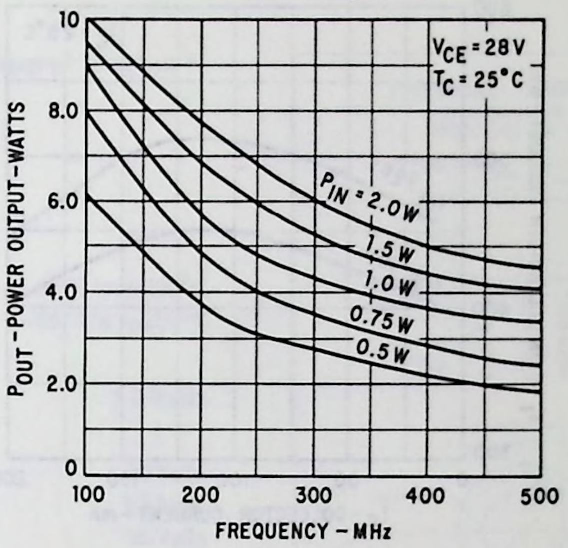
C_1, C_2, C_3, C_4: 3-35 pF
C_5: Not used
C_6: 1,000 pF
C_7: 0.005 μF, disc ceramic
L_1: 2 turns No. 16 wire, 3/16″ ID, 1/4″ long
L_2: Ferrite choke, Z = 450 ohms
L_3: 2 turns No. 16 wire, 1/4″ ID, 1/4″ long
L_4: 4 turns No. 16 wire, 3/8″ ID, 3/8″ long
R_1: Not used (emitter connected to ground)

TYPICAL PERFORMANCE CHARACTERISTICS
2N3375

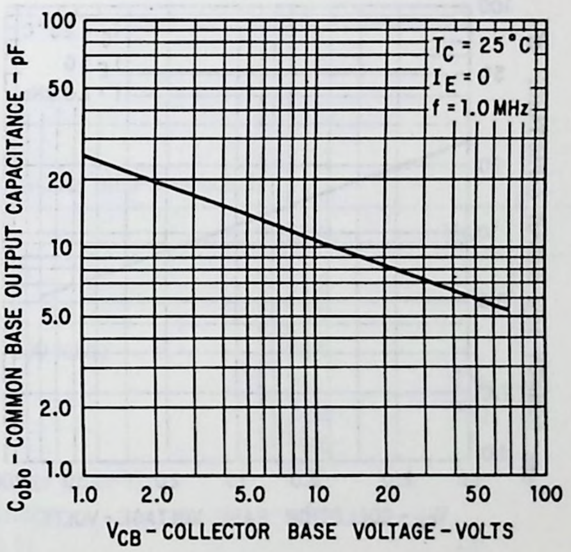
GAIN - BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



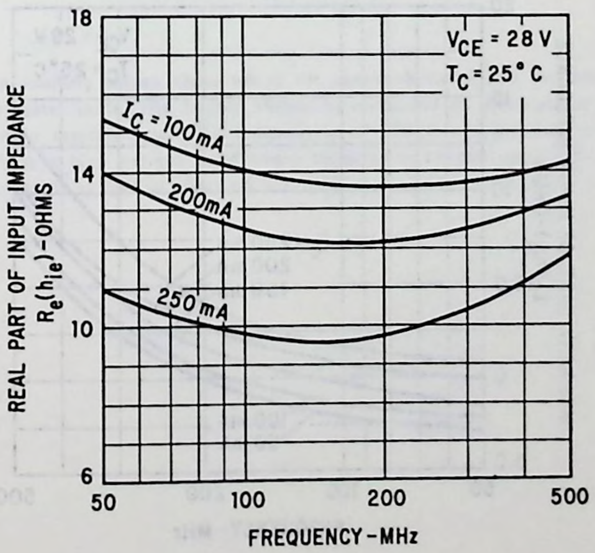
POWER OUTPUT VERSUS FREQUENCY



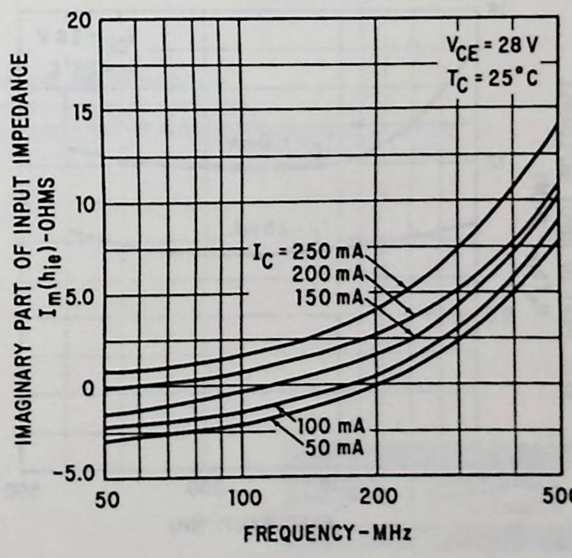
COMMON BASE OUTPUT CAPACITANCE VERSUS COLLECTOR BASE VOLTAGE



SERIES INPUT RESISTANCE VERSUS FREQUENCY

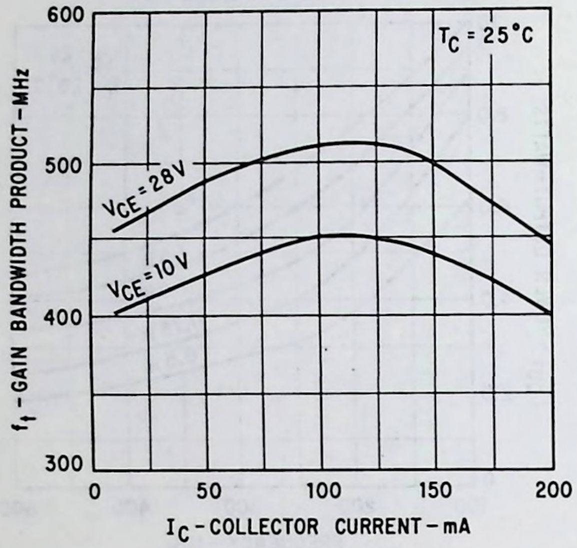


SERIES INPUT REACTANCE VERSUS FREQUENCY

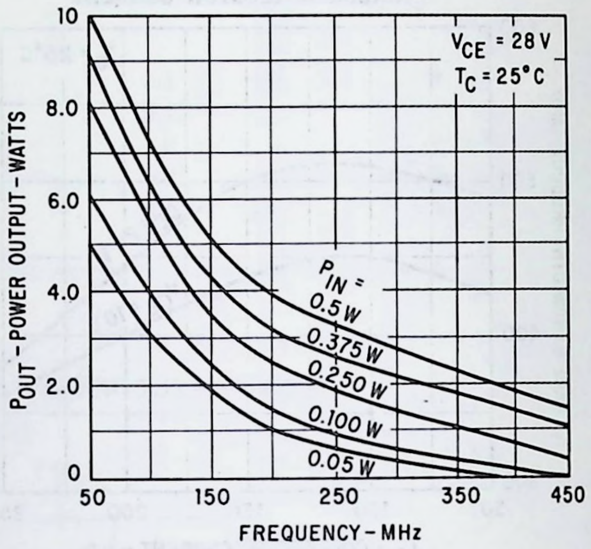


TYPICAL PERFORMANCE CHARACTERISTICS
2N3553

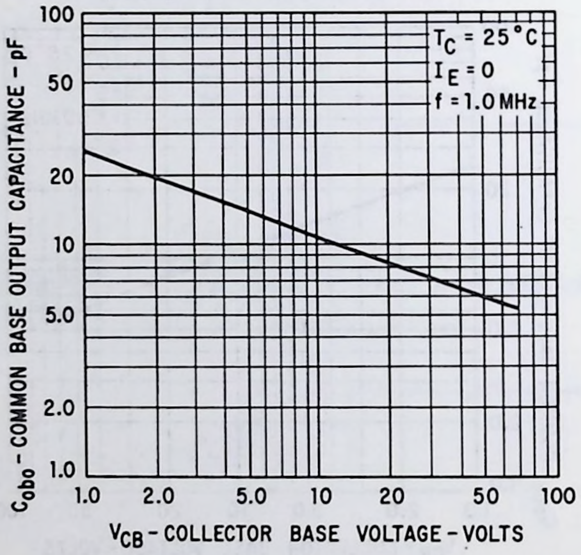
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



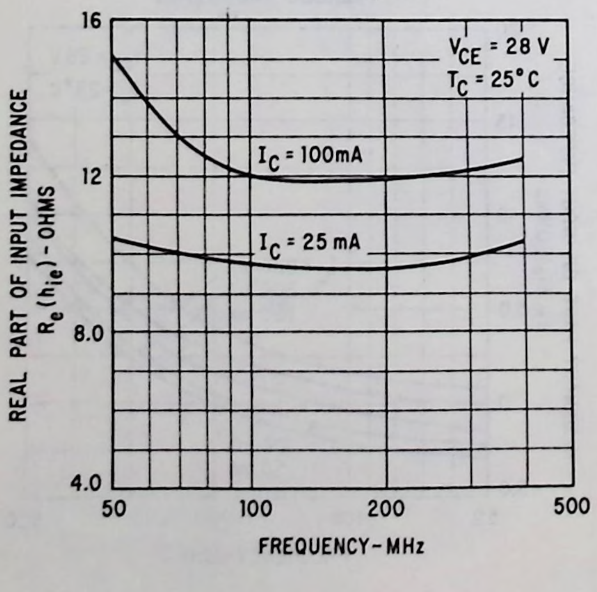
POWER OUTPUT VERSUS FREQUENCY



COMMON BASE OUTPUT CAPACITANCE VERSUS COLLECTOR BASE VOLTAGE



SERIES INPUT RESISTANCE VERSUS FREQUENCY



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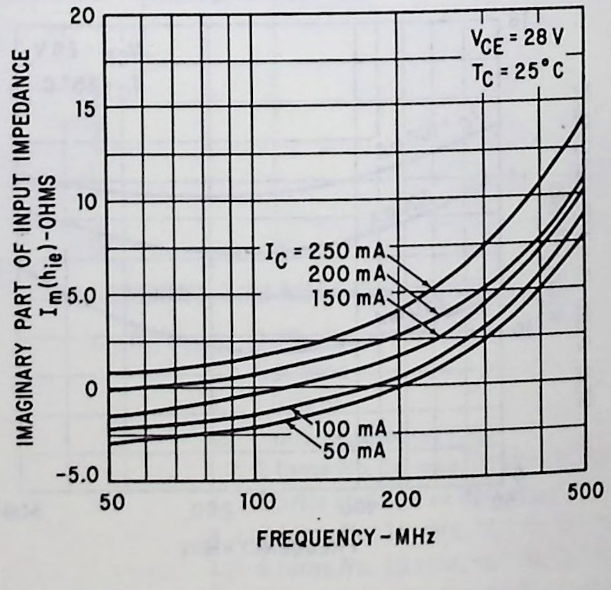


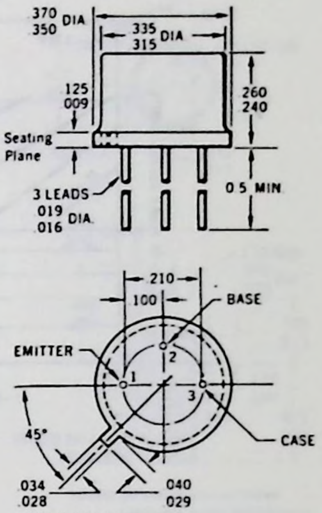
2N3866

NPN VHF-UHF OSCILLATOR, POWER AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION — The 2N3866 is a NPN, silicon epitaxial planar transistor designed for class A, B, or C amplifier circuits and VHF-UHF oscillator applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline



NOTES All dimensions in inches
Leads are gold plated over nickel flash on steel
Lead No. 3 internally connected to case
Package weight is 0.76 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		−65°C to +200°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature		5.0 Watts
Maximum Voltages and Currents		
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	3.5 Volts
V_{CES}	Collector to Emitter Voltage	55 Volts

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	MAX.	UNITS	TEST CONDITIONS	
P_{out}	RF Power Out (f = 400 MHz)	1.0		Watts	$P_{in} = 100$ mW	See Fig. 1
η	Collector Efficiency (f = 400 MHz)	45		%	$P_{out} = 1.0$ W	See Fig. 1
h_{fe}	High Frequency Current Gain (f = 200 MHz)	2.5			$I_C = 50$ mA	$V_{CE} = 15$ V
C_{ob}	Output Capacitance (f = 1.0 MHz)		3.0	pF	$V_{CB} = 28$ V	$I_E = 0$
h_{FE}	DC Pulse Current Gain (Note 5)	10	200		$I_C = 50$ mA	$V_{CE} = 5.0$ V
h_{FE}	DC Pulse Current Gain (Note 5)	5.0			$I_C = 360$ mA	$V_{CE} = 5.0$ V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 4)	30		Volts	$I_C = 5.0$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	55			$I_C = 5.0$ mA	$V_{BE} = 0$
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		1.0	Volts	$I_C = 100$ mA	$I_B = 20$ mA
I_{CEO}	Collector Cutoff Current		20	μA	$V_{CE} = 28$ V	$I_B = 0$

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/Watt (derating factor of 28.5 mW/°C).
(4) This rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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RF PERFORMANCE

RF POWER OUTPUT VERSUS FREQUENCY

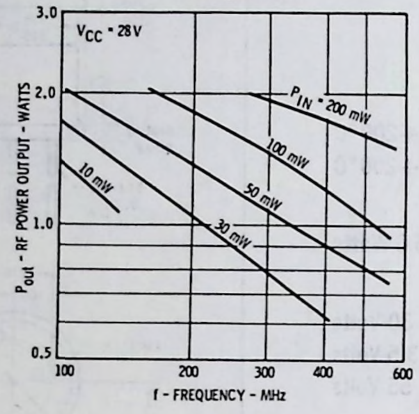
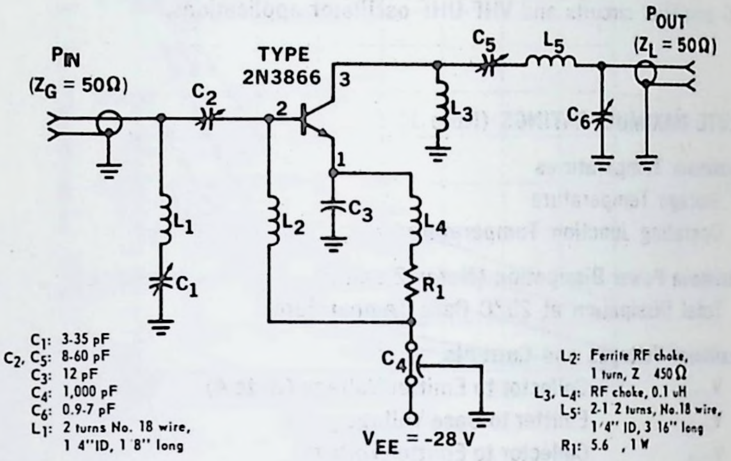


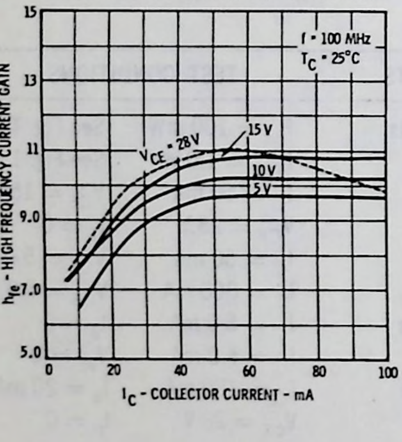
FIG. 1

RF AMPLIFIER CIRCUIT FOR POWER-OUTPUT TEST (400 MHz/s Operation)

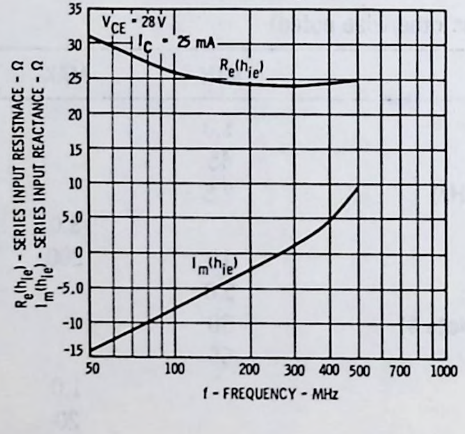


PIN
(ZG = 50Ω)
TYPE
2N3866
C2
2
3
1
C5
L5
POUT
(ZL = 50Ω)
L3
C6
L1
C1
L2
C3
L4
R1
C4
VEE = -28 V
C1: 3-35 pF
C2, C5: 8-60 pF
C3: 12 pF
C4: 1,000 pF
C6: 0.9-7 pF
L1: 2 turns No. 18 wire, 1 4"ID, 1 8" long
L2: Ferrite RF choke, 1 turn, Z 450 Ω
L3, L4: RF choke, 0.1 uH
L5: 2-1 2 turns, No.18 wire, 1/4" ID, 3 16" long
R1: 5.6 , 1 W

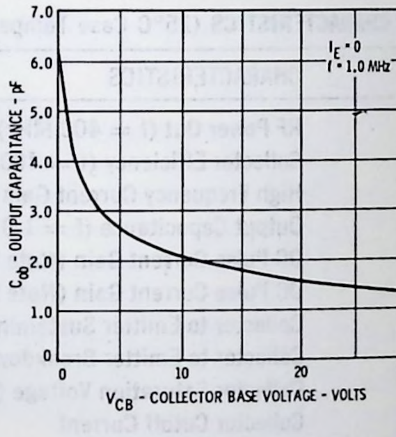
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



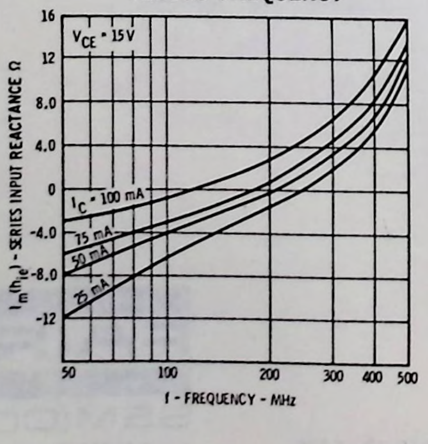
SERIES INPUT RESISTANCE AND REACTANCE VERSUS FREQUENCY



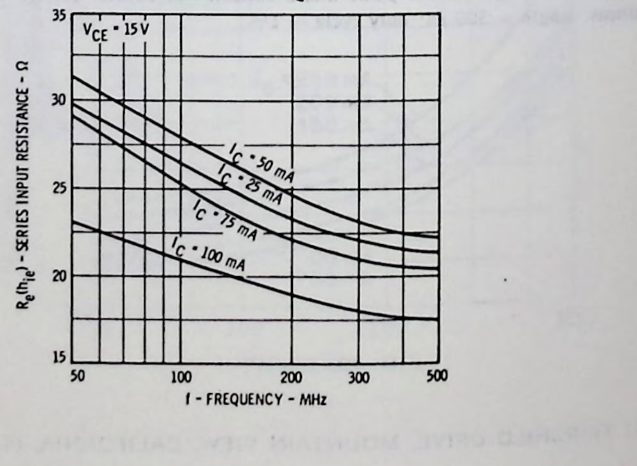
OUTPUT CAPACITANCE VERSUS COLLECTOR BASE VOLTAGE



SERIES INPUT REACTANCE VERSUS FREQUENCY



SERIES INPUT RESISTANCE VERSUS FREQUENCY



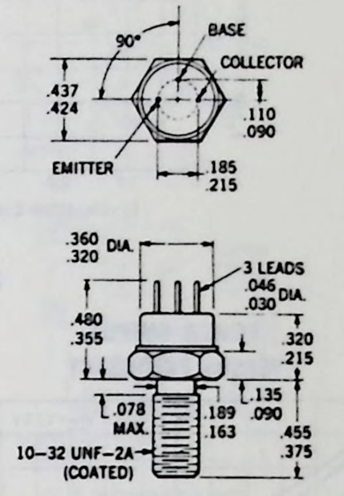
2N5025 · 2N5026

NPN VHF POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH RF POWER GUARANTEE** - - 13.5 V operation: 20 W @ 50 MHz, Pin = 3.5 W
  (Unneutralized, Class C) - - 28 V operation: 25 W @ 80 MHz, Pin = 2.5 W
- **HIGH LV_{CEO} AND BV_{CES}** - - 13.5 V operation: 40 V and 75 V
  - - 28 V operation: 50 V and 90 V
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-60)



NOTES: All dimensions in inches
Leads are nickel-plated kovar
Emitter internally connected to case
Package weight is 4.8 grams

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	− 65°C to + 200°C
Operating Junction Temperature	+ 200°C
Lead Temperature (soldering, 60 second time limit)	+ 300°C
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature	45 Watts
(See Maximum Permissible DC Power Dissipation Curve and Note 5)	

Maximum Voltages and Current		2N5025	2N5026
V_{CEO}	Collector to Emitter Voltage [Note 4]	40 Volts	50 Volts
V_{CES}	Collector to Emitter Voltage	75 Volts	90 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts	4.5 Volts
V_{CER}	Collector to Emitter Voltage	40 Volts	50 Volts
I_C	Collector Current	7.5 Amps	7.5 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

		2N5025			2N5026					
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
P_{out}	**Power Output (f = 50 MHz)**	20	22					Watts	$P_{in} = 3.5$ W	$V_{CC} = 13.5$ V
P_{out}	**Power Output (f = 80 MHz)**				25	30		Watts	$P_{in} = 2.5$ W	$V_{CC} = 28$ V
η	Collector Efficiency (f = 50 MHz)	65						%	$P_{out} = 20$ W	$V_{CC} = 13.5$ V
η	Collector Efficiency (f = 80 MHz)				65			%	$P_{out} = 25$ W	$V_{CC} = 28$ V
h_{fe}	High Frequency Current Gain (f = 50 MHz)	3.0	4.0		3.0	4.0			$I_C = 1.0$ A	$V_{CB} = 2.0$ V
C_{obo}	Collector Base Capacitance (f = 1.0 MHz)		54	85				pF	$V_{CB} = 13.5$ V	$I_E = 0$
C_{obo}	Collector Base Capacitance (f = 1.0 MHz)					43	60	pF	$V_{CB} = 28$ V	$I_E = 0$
BV_{CES}	**Collector to Emitter Breakdown Voltage**	75			90			Volts	$I_C = 5.0$ mA	$V_{BE} = 0$
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** [Notes 2 and 4]	40	65		50	75		Volts	$I_C = 200$ mA	$I_B = 0$
BV_{CER}	**Collector to Emitter Breakdown Voltage** [Note 4]	40			50			Volts	$I_C = 200$ mA	$R_{BE} = 10\ \Omega$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			4.5			Volts	$I_E = 1.0$ mA	$I_C = 0$
h_{FE}	DC Pulse Current Gain [Note 3]	20	40		20	40			$I_C = 2.0$ A	$V_{CE} = 2.0$ V
V_{CE}(sat)	Pulsed Collector Saturation Voltage [Note 3]			1.0			1.0	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
V_{BE}(sat)	Pulsed Base Saturation Voltage [Note 3]			1.5			1.5	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
I_{CES}	Collector Cutoff Current			10				μA	$V_{CE} = 50$ V	$V_{BE} = 0$
I_{CES}	Collector Cutoff Current						10	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{CES} (150°C)	Collector Cutoff Current			1.0				mA	$V_{CE} = 50$ V	$V_{BE} = 0$
I_{CES} (150°C)	Collector Cutoff Current						1.0	mA	$V_{CE} = 60$ V	$V_{BE} = 0$

(See notes on back page)

•Planar is a patented Fairchild p

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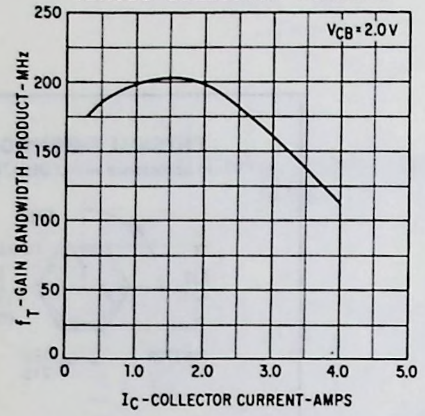
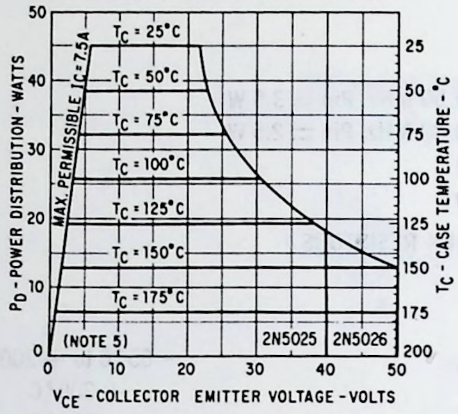
TYPICAL ELECTRICAL CHARACTERISTICS

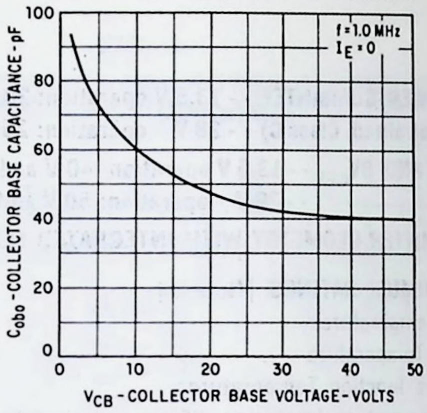
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

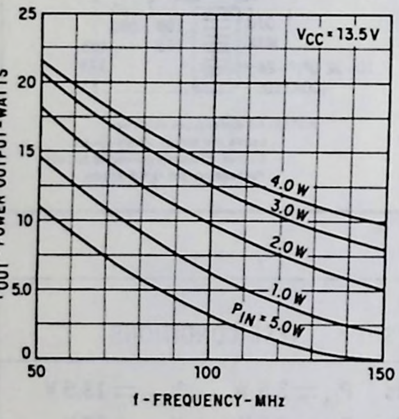


COLLECTOR BASE CAPACITANCE VERSUS COLLECTOR BASE VOLTAGE

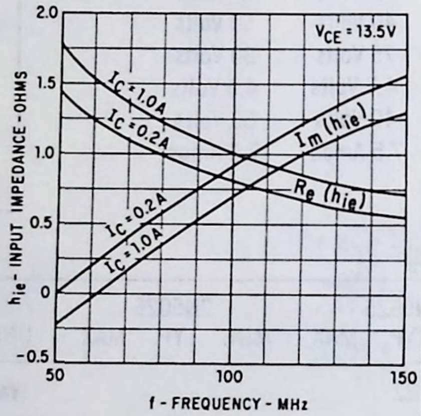


2N5025

POWER OUTPUT VERSUS FREQUENCY

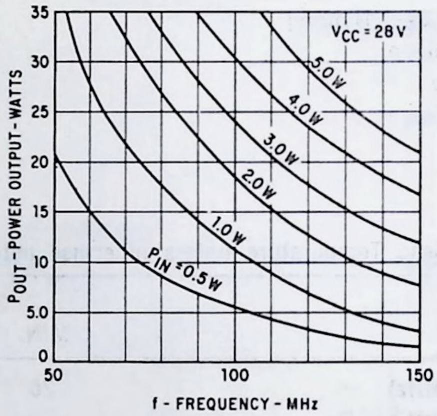


INPUT IMPEDANCE VERSUS FREQUENCY

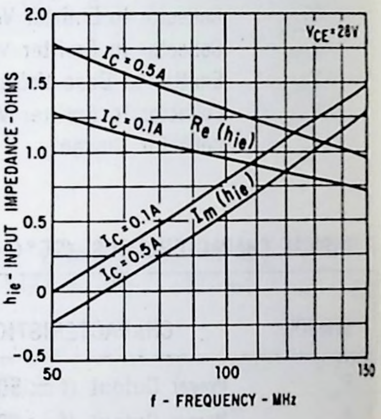


2N5026

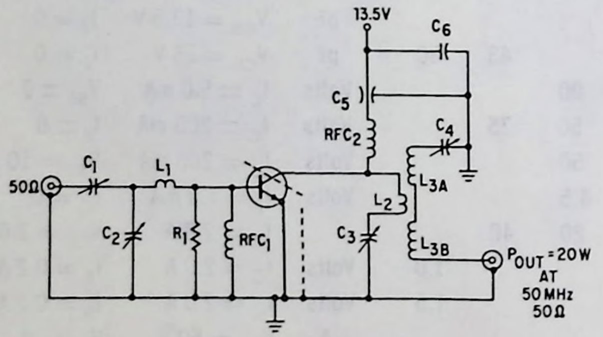
POWER OUTPUT VERSUS FREQUENCY



INPUT IMPEDANCE VERSUS FREQUENCY



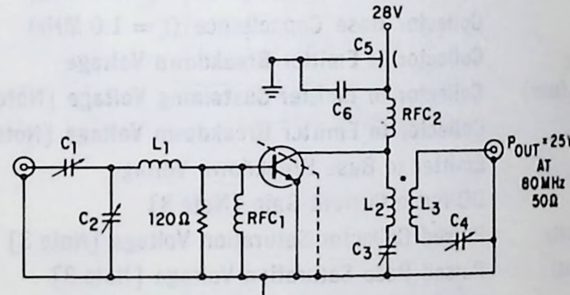
50 MHz AMPLIFIER TEST CIRCUIT



C_1 = 9 - 180 pF (ARCO #463 or Equivalent)
C_2 = 50 - 380 pF (ARCO #465 or Equivalent)
C_3 = 50 - 380 pF (ARCO #465 or Equivalent)
C_4 = 4 - 40 pF (ARCO #403 or Equivalent)
C_5 = 1000 pF Feed - thru
C_6 = 1.0 μF, 50 WVDC
L_1 = 2t., 1/8" dia. copper tubing, 1/2" I.D., 3/8" long, 0.10 μH, Qu > 200
L_2 = 2t., 1/8" dia. copper tubing, 3/4" I.D., 7/16" long, 0.13 μH, Qu > 200
L_{3A} = 4t., 1/8" dia. copper tubing, 3/4" I.D., 3/4" long } 1.0 μH, Qu > 200
L_{3B} = 6t., 1/8" dia. copper tubing, 3/4" I.D., 1" long
R_1 = 120 Ω non-inductive
RFC_1 = 7 μH (Ohmite Z - 50 or Equivalent)
RFC_2 = 11t., #22 enameled wire, close-wound, 1/4" I.D., 0.3 μH

Note: L_{3A} & L_{3B} are wound continuously with 1/2" space between sections to admit L_2. kHz$<$ K $\approx$ 0.2.

80 MHz AMPLIFIER TEST CIRCUIT



C_1 = 16 - 150 pF (ARCO #424 or equivalent)
C_2 = 24 - 200 pF (ARCO #425 or equivalent)
C_3 = 4 - 40 pF (ARCO #422 or equivalent)
C_4 = 2 - 25 pF (ARCO #421 or equivalent)
C_5 = 1000 μF, Feed - thru
C_6 = 1.0 μF, 50 WVDC
L_1 = 1t., 1/8" dia. copper tubing, 3/8" I.D., 3/8" long, 0.01 μH, Qu > 200
L_2 = 3t., 1/8" dia. copper tubing, 3/4" I.D., 5/8" long, 0.2 μH, Qu > 200
L_3 = 6t., 1/8" dia. copper tubing, 3/4" I.D., 1 1/16" long, 0.6 μH, Qu > 200
RFC_1 = 7.0 μH (Ohmite Z-50 or equivalent)
RFC_2 = 11t., #20 Nylclad copper wire, close wound, 1/4" I.D., 0.3 μH

Note: Spacing between L_2 and L_3 is 1 turn. kHz$<$ K $\approx$ 0.2

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) Ratings refer to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse conditions: length = 300 μs; duty cycle = 1%.
(4) Pulsed thru a 25MH inductor.
(5) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

MSA7505 • MSA8505

NPN VHF•UHF POWER TRANSISTORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — These devices are designed for use as RF Power Amplifiers with the maximum available safe operating area, thus making them ideal as drivers or output transistors for class A, B or C amplifier applications. These devices utilize Fairchild's unique discrete emitter thin film stabilizing resistors.

FEATURES

- **HIGH POWER STABILITY THROUGH DISCRETE EMITTER THIN FILM RESISTORS**
- **MAXIMUM SAFE OPERATING AREA — NO SECOND BREAKDOWN TO 30 VOLTS**
- **IMPROVED HIGH FREQUENCY PERFORMANCE IN A LOW INDUCTANCE STRIPLINE PACKAGE (MSA8505)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

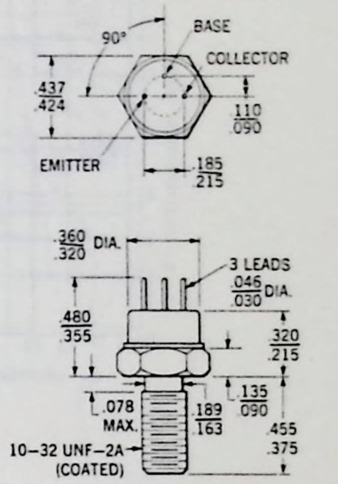
	MSA7505	**MSA8505**
Maximum Temperatures		
Storage Temperature	−65°C to +200°C	−65°C to +200°C
Operating Junction Temperature	200°C	200°C
Lead Temperature (Soldering, 10 seconds time limit)		
$\geq$ 1/32″ from Ceramic Disk	230°C	
$\geq$ 1/4″ from Encapsulated Area		270°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Power Dissipation at 25°C Case Temperature	25 W	21 W

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	65 Volts
V_{CER}	Collector to Emitter Voltage (Note 4)	55 Volts
V_{CEO}	Collector to Emitter Voltage	33 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Collector Current	3.0 A

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-60)



NOTES: All dimensions in inches
Leads are gold-plated kovar
Emitter internally connected to case
Package weight is 4.8 grams

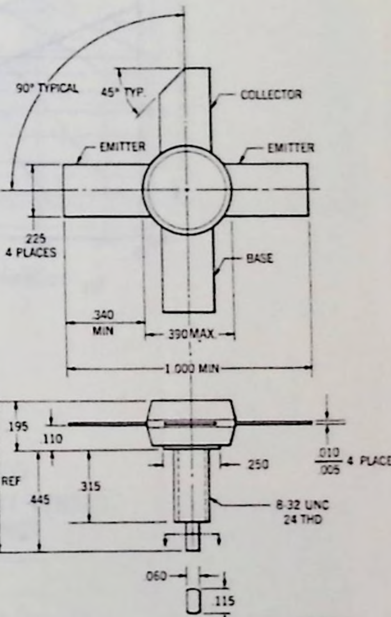
MSA7505

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MSA7505 MIN.	MSA7505 TYP.	MSA7505 MAX.	MSA8505 MIN.	MSA8505 TYP.	MSA8505 MAX.	UNITS	TEST CONDITIONS	
P_{OUT}	Power Output (f = 400 MHz)				10			Watts	$P_{IN} = 2.75$ W	$V_{CC} = 28$ V
P_{OUT}	Power Output (f = 400 MHz)	10						Watts	$P_{IN} = 3.5$ W	$V_{CC} = 28$ V
η	Collector Efficiency (f = 400 MHz)	60			60			%	$P_{OUT} = 10$ W	$V_{CC} = 28$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5	4.35		2.5	4.35			$I_C = 0.5$ A	$V_{CE} = 3.0$ V
C_{ob}	Collector to Base Capacitance (f = 1.0 MHz)			20			20	pF	$I_C = 0$	$V_{CB} = 28$ V
$V_{CES(BR)}$	Collector to Emitter Breakdown Voltage	65			65			Volts	$I_C = 5.0$ mA	$V_{BE} = 0$
$V_{CER(BR)}$	Collector to Emitter Breakdown Voltage (Note 4)	55			55			Volts	$I_C = 200$ mA	$R_{BE} = 10\ \Omega$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	33	45		33	45		Volts	$I_C = 50$ mA	$I_B = 0$
$V_{EBO(BR)}$	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	$I_E = 1.0$ mA	$I_C = 0$
h_{FE}	DC Pulse Current Gain (Note 5)	10			10				$I_C = 1.0$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current			5.0			5.0	mA	$V_{CE} = 65$ V	$V_{BE} = 0$ V
I_{CES}(150°C)	Collector Cutoff Current			5.0			5.0	mA	$V_{CE} = 30$ V	$V_{BE} = 0$ V

See Notes on Page 2

PHYSICAL DIMENSIONS



Note: All dimensions in inches

MSA8505

*Planar is a patented Fairchild process.

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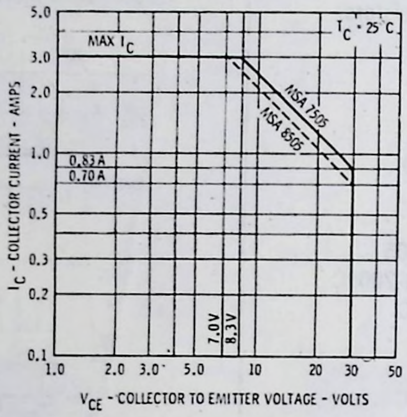
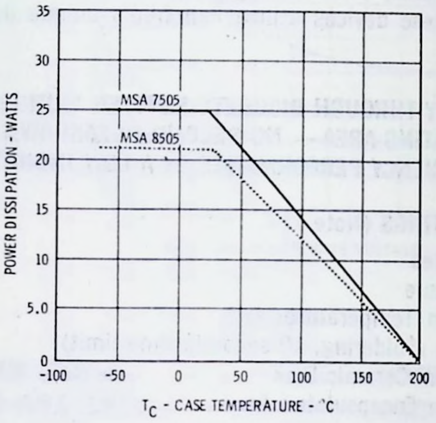
SAFE OPERATING AREA

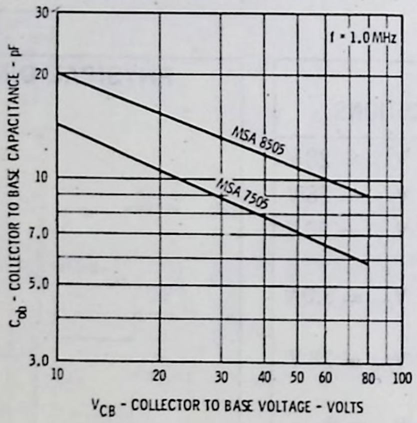
DC SAFE OPERATING AREA CURVE



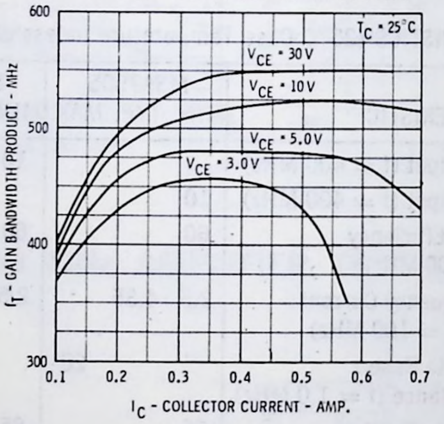
POWER DISSIPATION DERATING CURVE



COLLECTOR TO BASE CAPACITANCE VERSUS COLLECTOR TO BASE VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

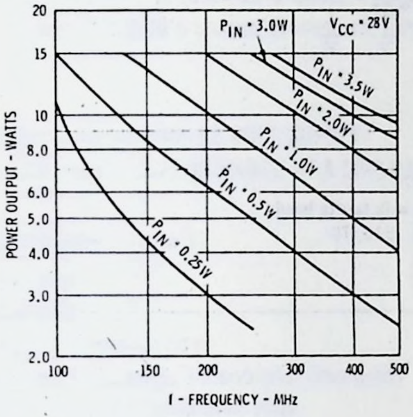


NOTES:

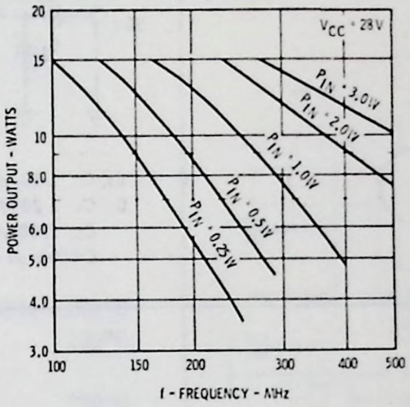
(1) These ratings are limiting values above which the servicability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 7.0°C/Watt for MSA7505 and 8.34°C/Watt for MSA8505.
(4) Pulsed through a 25 mH inductor.
(5) Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.

TYPICAL POWER OUTPUT VERSUS FREQUENCY AND VOLTAGE

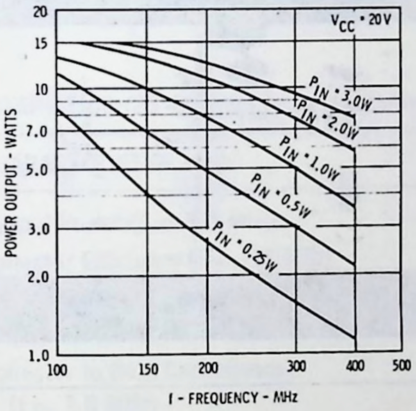
MSA7505
POWER OUTPUT VERSUS
FREQUENCY



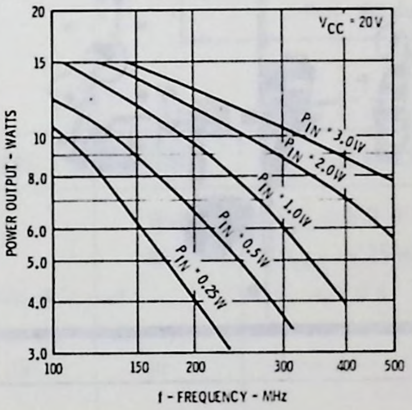
MSA8505
POWER OUTPUT VERSUS
FREQUENCY



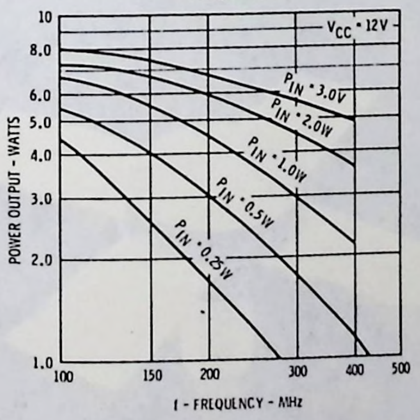
MSA7505
POWER OUTPUT VERSUS
FREQUENCY



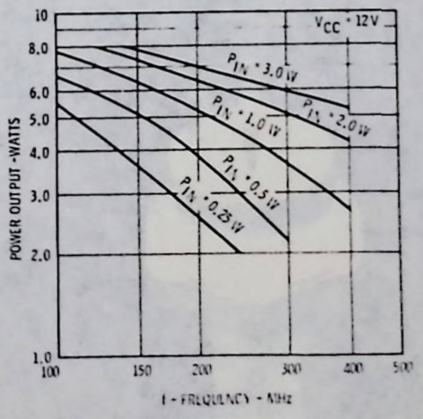
MSA8505
POWER OUTPUT VERSUS
FREQUENCY



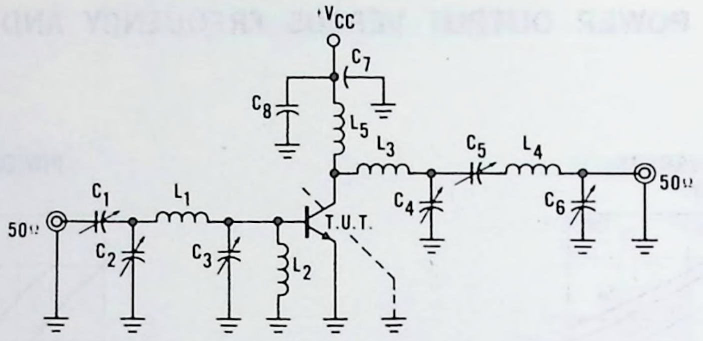
MSA7505
POWER OUTPUT VERSUS
FREQUENCY



MSA8505
POWER OUTPUT VERSUS
FREQUENCY

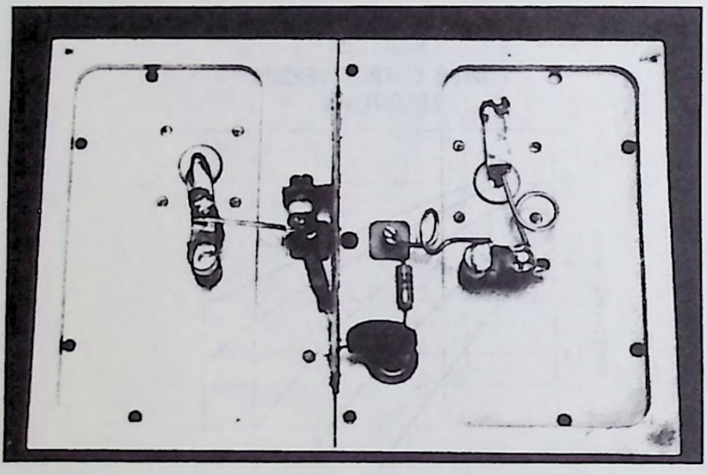


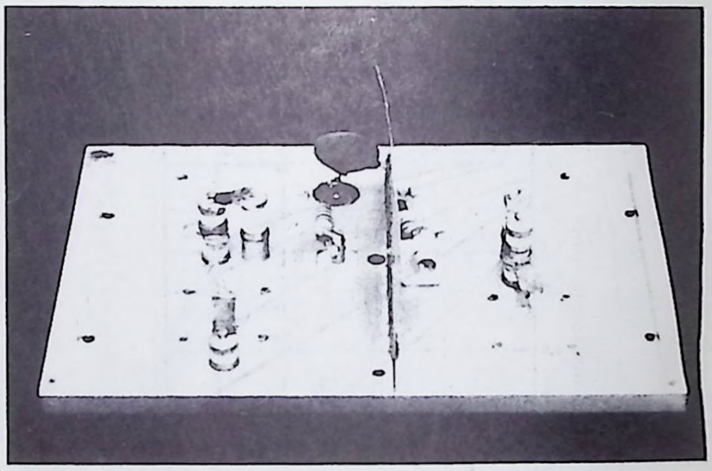
400 MHz RF TEST AMPLIFIER


+V_{CC}
C_7
C_8
L_5
L_3
C_5
L_4
50Ω
C_1
L_1
C_4
C_6
50Ω
C_2
C_3
L_2
T.U.T.

C_1, C_3, C_5, C_6: 1-10 pF
C_2, C_4: 1-20 pF
C_7: 1000 pF
C_8: 0.1 μF disk

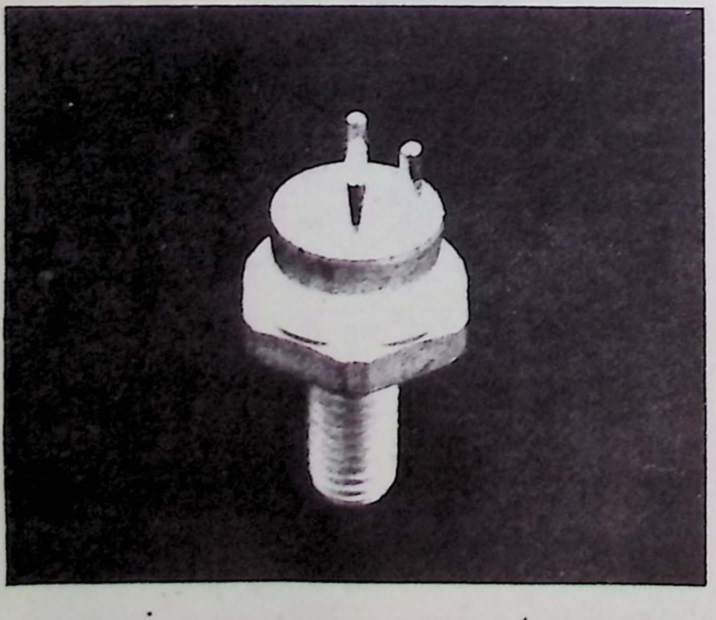
L_1: 1", #16, TC
L_2: .15 μH RFC with ferrite bead
L_3, L_4: IT, 5/16" d, #16, TC
L_5: .15 μH RFC



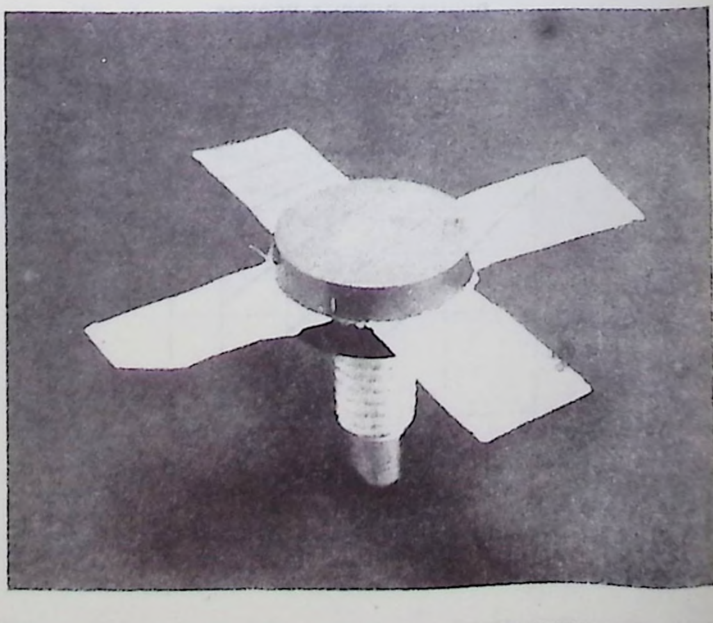


PACKAGE PICTURES

MSA7505



MSA8505



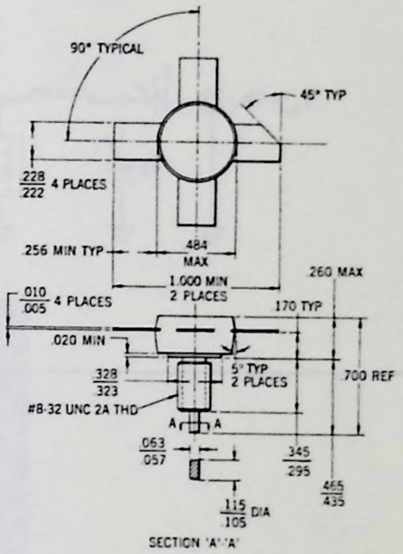
MSA8506

NPN VHF•UHF POWER TRANSISTOR

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION — This device is designed for use as RF Power Amplifier with the maximum available safe operating area, thus making it ideal as a driver or output transistor for class A, B or C amplifier applications. This device utilizes Fairchild's unique discrete emitter thin film stabilizing resistors.

PHYSICAL DIMENSIONS



Note: All dimensions in inches

FEATURES

- **HIGH POWER PERFORMANCE FROM 12 VOLT SUPPLY**
- **IMPROVED HIGH FREQUENCY PERFORMANCE IN A LOW INDUCTANCE STRIPLINE PACKAGE**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		200°C
Lead Temperature (Soldering, 10 seconds time limit) ≥ 1/32″ from Encapsulated Area		230°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Power Dissipation at 25°C Case Temperature		50 W
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	36 V
V_{CEO}	Collector to Emitter Voltage	18 V
V_{EBO}	Emitter to Base Voltage	4.0 V
I_C	Collector Current	5.0 A

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
P_{OUT}	Output Power (f = 175 MHz)	25			Watts	$P_{IN} = 8.0$ W	$V_{CC} = 12$ V
η	Collector Efficiency (f = 175 MHz)		65		%	$P_{OUT} = 25$ W	$V_{CC} = 12$ V
h_{fe}	High Frequency Current Gain (f = 100 MHz)		2.5			$I_C = 2.0$ A	$V_{CE} = 5.0$ V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)			100	pF	$I_E = 0$	$V_{CB} = 12$ V
$V_{CES(BR)}$	Collector to Emitter Breakdown Voltage	36			Volts	$I_C = 10$ mA	$V_{BE} = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	18			Volts	$I_C = 100$ mA	
$V_{EBO(BR)}$	Emitter to Base Breakdown Voltage	4.0			Volts	$I_E = 5.0$ mA	$I_C = 0$
h_{FE}	DC Pulse Current Gain (Note 4)	5.0				$I_C = 2.0$ A	$V_{CE} = 5.0$ V

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 3.5°C/Watt.
(4) Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.

***Planar is a patented Fairchild process.**

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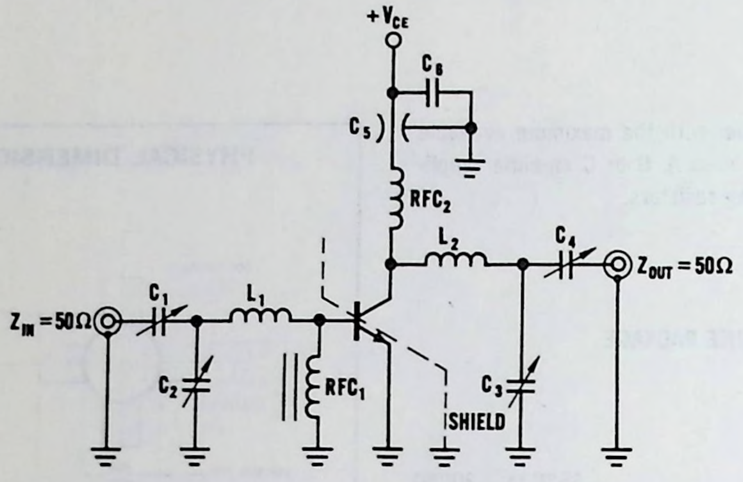
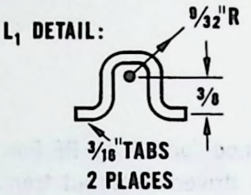
175 MHz RF TEST AMPLIFIER


+V_{CE}
C6
C5
RFC2
L2
C4
Z_OUT = 50Ω
Z_IN = 50Ω
C1
L1
C2
RFC1
C3
SHIELD

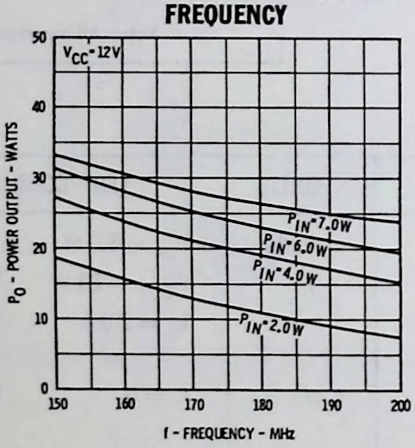

L1 DETAIL:
9/32"R
3/8
3/16"TABS
2 PLACES

MATERIAL:

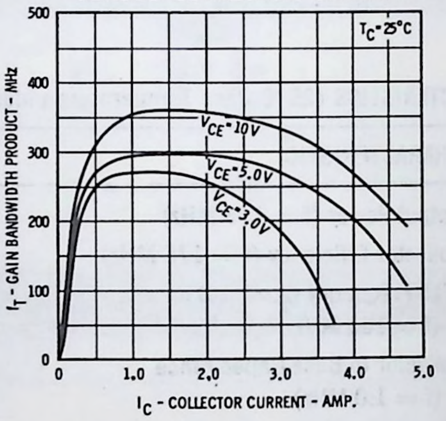
1/8" OUTSIDE DIAMETER COPPER TUBING

C_1 — (ARCO 402) 1.5 - 20 pF trimmer
C_2, C_4 — (JOHANSON 3906) 1.0 - 20 pF air trimmer
C_3 — (JOHANSON 3901) 1.0 - 14 pF air trimmer
C_5 — 1,000 pF feed-thru
C_6 — .025 μF, 50 V disc ceramic
L_1 — See Detail
L_2 — 3 t. 1/8" copper tube(OD), silver plated, 5/16" I.D., 3/4" L.
RFC_1 — Ohmite Z-144
RFC_2 — 8 t. #16 TC wire, 3/16" I.D., 5/8" L.

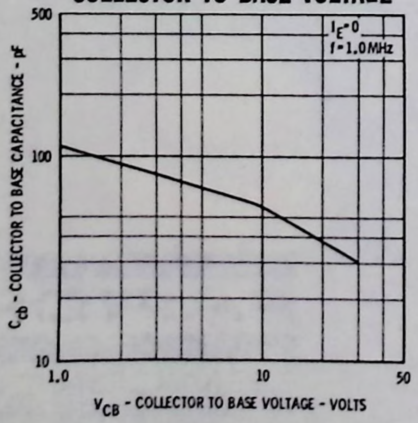
POWER OUTPUT VERSUS FREQUENCY



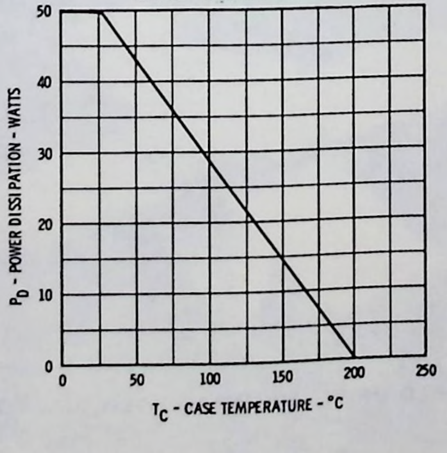
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



COLLECTOR TO BASE CAPACITANCE VERSUS COLLECTOR TO BASE VOLTAGE



POWER DISSIPATION VERSUS CASE TEMPERATURE



Application Notes and Technical Papers

APPLICATION NOTES - NUMERIC LISTING

APP-41	Stable Wideband Emitter Followers — Paul J. Beneteau
APP-59	An Improved Emitter-Coupled Multivibrator — P. J. Beneteau and A. Evangeliste
APP-61/2	Long Delay Transistor Timer — P. Alderisio
APP-64	Application of Milliwatt Micrologic® Elements — H. T. Chua
APP-85	Micrologic® Shift Counters — George Powers
APP-87	A Varactor Bias Servo System — Bruce O. Anderson
APP-88	Medium Power Silicon Transistor DC to DC Converters — Thomas B. Mills
APP-93	Transient Response Characteristics of Phototransistors — George T. Daughters
APP-103	Applications of the Silicon Planar* Field-Effect Transistor — Larry Blaser and John MacDougall
APP-105	A Monolithic Operational Amplifier — Robert Widlar
APP-106	Using Fairchild Integrated Circuits as Monostable Multivibrators — Robert Ricks
APP-107	Diode Transistor Micrologic® — George Powers
APP-109	Applications of the Silicon Planar* II MOS FET — John MacDougall
APP-111	The Improved μA702** Wideband DC Amplifier — Robert Widlar
APP-114	μA702** Circuit Design Ideas — (Six Authors)
APP-115	Maximum Integrated Circuit Utilization Through Mixing Compatible Logic Families — Robert Ricks
APP-116	The Operation and Use of a Fast Integrated Circuit Comparator — Robert Widlar
APP-117	Frequency Compensation Techniques for an Integrated Operational Amplifier — James Giles
APP-118	Counter Micrologic® A New Dimension in Multi-Function Integrated Circuits — George Powers
APP-119	Ways to Increase Speed in Large Count Binary Counters — Jack Irwin
APP-120	Using the J-K Flip-Flop in Small Modulo Counters — Jack Irwin
APP-121	A High-Efficiency Power Supply Using Micrologic® Integrated Circuits — Samuel Schwartz
APP-123	Core Memory Sense Amplifier Designs Using an Integrated Dual Comparator — Robert Widlar
APP-124	Designing with Off-the-Shelf Linear Microcircuits — Robert Widlar and James Giles
APP-125	A Versatile Tester for Linear Integrated Circuits — James Giles
APP-128	Complementary Transistor Micrologic® Integrated Circuits — R. C. Ghest
APP-130	Aids for Digital IC Systems — Murray Siegel and Lee Marley
APP-131	Transistor-Transistor Micrologic® Integrated Circuits — John Nichols
APP-132	Single-Phase Control for Cycloconverter — Samuel Schwartz
APP-133	Precision Electronic Digital Clock Uses IC's — B. Jensen and J. Irwin
APP-134	Effect of Integrated Circuits on Systems — Comparative Case — Robert Ricks
APP-135	Performance of the μA703 in 100 MHz and 200 MHz Amplifiers and 100 MHz Harmonic Mixers — David Bingham
APP-139	Multivibrator-Type Vertical-Deflection Circuit for Television — J. S. MacDougall
APP-141	Transistorized TV Horizontal Driver System — Larry Blaser and Hermann Ebenhoech
APP-142	15-Watt Audio Amplifier with Short-Circuit Protection — Don Smith
APP-143	A Horizontal Oscillator for Transistorized TV Set — Larry Blaser and Hermann Ebenhoech
APP-144	Frequency Synthesizer for 27 MHz Citizens' Band Transceiver — Larry Blaser
APP-145	Color Television Chroma Reference Systems Using the μA703 — Larry Blaser and Norm Sturn
APP-146	Color TV Sound System Using the Fairchild μA703 — Larry Blaser
APP-147	Characterization and Application of μA703 in Four-Stage High-Quality FM IF Amplifier — David Bingham
APP-148	25-Watt Audio Amplifier with Short-Circuit Protection — Derek Bray and Wesley Votipka
APP-149	Semiconductor Circuits for 19-inch Black and White Television Receivers — Derek Bray
APP-150	Semiconductor Circuits for Hybrid Color Television — Derek Bray

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*Planar is a patented Fairchild process.

**The μA702 is renumbered the μA702A.

APPLICATION NOTES/TECHNICAL PAPERS, NUMERIC LISTING

APP-151	High-Performance Integrated FM IF Strips — Ted Hanna
APP-152	250 MHz Distributed Amplifier Suitable for CATV Truck Line — Larry Blaser and Norman Sturn
APP-153	Logic Designs Using the TTμL9008 — Clive Ghest
APP-154	Compatible Current Sinking Logic — Abe Marder and Ralph Bennett
APP-155	Industrial Code Conversion — Don Femling
APP-156	Designing with the μA703 Monolithic RF-IF Amplifier — G. J. Estep
APP-157	A Fixed-Gain Low-Distortion AF Amplifier — G. J. Estep
APP-158	Two High-Performance Monolithic Microcircuits for FM Sound System — David Bingham
APP-159	A Low-Cost AM-FM Radio Employing an Integrated Circuit Design — David Bingham and John (Ted) Hanna
APP-160	Applications of the CCSL 9301 Decoder — R. Clive Ghest
APP-161	CCSL 9300 Shift Register — John L. Nichols
APP-163	Applications of the CCSL 9304 Dual Adder — R. Clive Ghest
APP-164	Application of the μA722 10-Bit Current Source — M. Rudin, G. Erdi, R. Walker, R. Ricks
APP-165	SH3200-SH3201 Hybrid DC Voltage Regulators — S. K. Leong
APP-166	HLLDTμL Integrated Circuits — R. Repass, O. Lykins
APP-167	MSI 9308 Dual 4-Bit Latch — R. C. Ghest
APP-168	Applications of the 9034 Read-Only Memory — P. F. Schenck
APP-169	CCSL 9306 Up-Down BCD Counter — R. C. Ghest, S. Simonsen
APP-170	Applications of the 9311-One-Out-of-16-Decoder — R. C. Ghest
APP-171	Applications of the μA739 and μA749 Dual Preamplifier Circuits in Home Entertainment Equipment — D. Campbell, et al
APP-172	The 3800 Arithmetic Unit — P. Schenck
APP-173	The 9601 - A Second Generation One-Shot — J. Anderson, T. Gray, R. Walker
APP-174	A Low-Cost Hybrid Color TV Receiver — N. Doyle, D. Smith
APP-175	A Low-Noise Dual Operational Amplifier — D. Long, D. Campbell
APP-176	A Digital Frequency Synthesizer for Airborne Navigation or Communications Transceiver — M. Nichols, J. Stinehelfer
APP-177	The Hot Carrier Mixer Diode — S. Sir
APP-178	A Navigation Receiver Using a Digital Frequency Synthesizer — J. Stinehelfer
APP-179	Line-Operated Phono Circuits Using the PFB 1400 — D. Campbell, R. Westlake

TP-24	Overloading and Spurious Responses in Transistor FM Tuners — Earl Cummins
TP-27	Forward AGC Design Considerations in Transistorized Television Receivers — Harry Suzuki
TP-28	Measurement of Transistor High-Frequency Current Gain — Heitor Franco
TP-31	An FM Tuner Using MOS-FET's and Integrated Circuits — John Barrett, Larry Blaser, and Harry Suzuki
TP-32	A Unique Circuit Design for a High-Performance, Operational Amplifier Especially Suited to Monolithic Construction — Robert Widlar
TP-33	Some Circuit Design Techniques for Linear Integrated Circuits — Robert Widlar
TP-35	A Black and White and Color TV Video I-F Output Transistor — Derek Bray and Philip Froess
TP-36	A Low Noise, AGC Silicon Transistor Useful From LF to UHF — David Bingham, Harry Suzuki, and Charles Watson
TP-37	Integrated Circuits in Industrial Control — Donald Femling and Jack Irwin
TP-38	Semiconductor Video Amplifiers for Monochrome and Color Receivers — Derek Bray
TP-39	A New 400-Volt Horizontal Output Transistor — T. B. Mills and E. F. Kiburis
TP-40	Radiation Testing of Linear Microcircuits — J. Darryl Lieux
TP-41	Space and Nuclear Environments and their Effects on Semiconductors — David K. Myers
TP-42	Novel Multi-Purpose LIC's Introduce New Concepts into Circuit Design — David Bingham
TP-43	Color TV Processing Using Integrated Circuits — Larry Blaser and Derek Bray
TP-44	Let's Clarify IC Noise Margins — R. Clive Ghest
TP-46	TTμL Integrated Circuits: High Speed Considerations — R. C. Ghest

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Note: The following publications are obsolete and out of print:
APP's 1-40, 42-58, 60, 62, 63, 65-84, 86, 89-92, 94-102, 104, 108, 110, 112, 113, 122, 126, 127, 129, 138, 140.
TP's 1-23, 25, 26, 29, 30, 34.

Ordering Information

EXPLANATIONS

TRANSISTORS

MINIMUM ORDER $50.00

MILITARY APPROVED DEVICES:

All Fairchild devices, which indicate type of approval and slash number (USN/177A), are approved to Military Specification 19500.

NASA ORDERS:

For all NASA orders placed with the factory for less than $1,000.00, a $100.00 data charge will be added.

MIXING PRIVILEGES:

There is no Transistor mixing privilege for price advantage.

TRANSISTORS TYPE DESIGNATION:

C = Chopper
DM = Dual & Miniature Devices
DR = Core Driver/Film Driver
EN = Epoxy
FET-NCJ = Field Effect Transistor-N Channel Junction
GPA = General Purpose Amplifier

MOS/FET = Metal over Silicon/Field Effect Transistor
MT = Microwave Transistor
PT/T = Transistor Photo Device
PWR = Power
RFP = RF Power
R&I = RF & IF Amplifier

RR = Radiation Resistant
SCR = Silicon Controlled Rectifier
S/K = Sonobuoy Kit
SP = Special Product
Sw = Switch

DIODES

MINIMUM ORDER $50.00

MILITARY APPROVED DEVICES:

All Fairchild Devices, which indicate type of approval and slash number (JAN/177A), are approved to Military Specification 19500.

DIODE TYPE DESIGNATIONS:

FD 1, 2, 6 & 7 = Switching Diode Families
FD 3 = Low-Leakage Diode

HCD = Hot Carrier Diode
R = Reference Diode

VVC = Voltage Variable Capacitor
X = Zener Diode

PHOTO DEVICES AND COMPLEX OPTICAL ARRAYS

MINIMUM ORDER $50.00

MILITARY APPROVED DEVICES:

All Fairchild devices, which indicate type of approval and slash number (USN/177A), are approved to Military Specification 19500.

MIXING PRIVILEGES: NONE

PHOTO DEVICES DESIGNATIONS:

ALD = Avalanche Luminescent Diode
PD = Photodiode
PT = Phototransistor
PTRA = Photo Tape Reader Array

COMPLEX OPTICAL ARRAYS DESIGNATIONS:

ALDA = Avalanche Luminescent Diode Array
IPDA = Integrated Photodiode Array
IPTA = Integrated Phototransistor Array

FAIRCHILD SEMICONDUCTOR

TERMS AND CONDITIONS OF SALE

1. **SCOPE** — THE TERMS AND CONDITIONS OF SALE CONTAINED HEREIN APPLY TO ALL QUOTATIONS MADE AND PURCHASE ORDERS ENTERED INTO BY THE SELLER. THE SAID TERMS AND CONDITIONS MAY IN SOME INSTANCES CONFLICT WITH SOME OF THE TERMS AND CONDITIONS AFFIXED TO THE FORM OR ORDER BLANK AND/OR SPECIFIED BY THE BUYER. THEREFORE, ACCEPTANCE OF THE BUYER'S ORDER IS MADE ONLY ON THE EXPRESS UNDERSTANDING AND CONDITION THAT INSOFAR AS THE TERMS AND CONDITIONS OF THIS ACCEPTANCE CONFLICT WITH ANY TERMS AND CONDITIONS OF THE BUYER'S ORDER, THE TERMS AND CONDITIONS OF THIS ACCEPTANCE SHALL GOVERN, IRRESPECTIVE OF WHETHER THE BUYER ACCEPTS THESE CONDITIONS BY A WRITTEN ACKNOWLEDGMENT, BY IMPLICATION, OR ACCEPTANCE AND PAYMENT OF GOODS ORDERED HEREUNDER. SELLER'S FAILURE TO OBJECT TO PROVISIONS CONTAINED IN ANY COMMUNICATION FROM BUYER SHALL NOT BE DEEMED A WAIVER OF THE PROVISIONS OF THIS ACCEPTANCE. ANY CHANGES IN THE TERMS AND CONDITIONS OF SALE CONTAINED HEREIN MUST SPECIFICALLY BE AGREED TO IN WRITING BY THE GENERAL MANAGER OF THE SELLER BEFORE BECOMING BINDING ON EITHER THE SELLER OR THE BUYER.

   All orders or contracts must be approved and accepted by the Seller at its home office.

   The said terms and conditions of sale shall be applicable whether or not they are attached to or enclosed with the products to be sold or sold hereunder.

   Prices quoted for the items described above and acknowledged hereby are firm and not subject to audit, price revision, or price redetermination.

2. **TERMS OF PAYMENT** — All invoices are due and payable 30 days from date of invoice. No discounts are authorized.

   F. O. B. POINT — All sales are made F. O. B. point of shipment. Seller's title passes to Buyer and Seller's liability as to delivery ceases upon making delivery of material purchased hereunder to carrier at shipping point in good condition; the carrier acting as Buyer's agent. All claims for damages must be filed with the carrier. All shipments will normally be made by Parcel Post, Railway Express, Air Express or Air Freight. Unless specific instructions from Buyer specify which of the foregoing methods of shipment is to be used, the Seller will exercise his own discretion.

4. **DELIVERY** — Shipping dates are approximate and are based upon prompt receipt from Buyer of all necessary information. In no event will Seller be liable for any reprocurement costs, nor for delay or non-delivery, due to causes beyond its reasonable control, including but not limited to acts of God, acts of civil or military authority, priorities, fires, strikes, lockouts, slowdowns, factory or labor conditions, errors in manufacture and inability due to causes beyond the Seller's reasonable control to obtain necessary labor, materials, or manufacturing facilities. In the event of any such delay the date of delivery shall, at the request of the Seller, be deferred for a period equal to the time lost by reason of the delay.

5. **TAXES** — Unless otherwise specifically provided herein, the amount of any present or future sales, revenue, excise or other tax applicable to the products covered by this order or the manufacture or sale thereof, shall be added to the purchase price and shall be paid by the Buyer, or in lieu thereof the Buyer shall provide the Seller with a tax exemption certificate acceptable to the taxing authorities.

6. **PATENTS** — The Buyer shall hold the Seller harmless against any expense or loss resulting from infringement of patents or trademarks arising from compliance with Buyer's designs or specifications or instructions. The sale of products by the Seller does not convey any license, by implication, estoppel, or otherwise, under patent claims covering combinations of said products with other devices or elements.

   Except as otherwise provided in the preceding paragraph, the Seller shall defend any suit or proceeding brought against the Buyer so far as based on a claim that any product, or any part thereof, furnished under this contract constitutes an infringement of any patent of the United States, if notified promptly in writing and given authority, information and assistance (at the Seller's expense) for the defense of same, and the Seller shall pay all damages and costs awarded therein against the Buyer. In case said product, or any part thereof, is in such suit held to constitute infringement and the use of said product or part is enjoined, the Seller shall, at its own expense, either procure for the Buyer the right to continue using said product or part, or replace same with non-infringing product, or modify it so it becomes non-infringing, or remove said product and refund the purchase price and the transportation and installation costs thereof. The foregoing states the entire liability of the Seller for patent infringement by the said products o any part thereof.

7. **ASSIGNMENT** — The Buyer shall not assign his order or any interes therein or any rights thereunder without the prior written consent of Seller

8. **WARRANTY** — The Seller warrants that the articles to be delivered unde this purchase order will be free from defects in material and workmanship under normal use and service. Seller's obligations under this warranty are limited to replacing or repairing, at its option, at its factory, any of said articles which shall within one (1) year after shipment be returned to the Seller's factory of origin, transportation charges prepaid, and which are after examination, disclosed to the Seller's satisfaction to be thus defective. THIS WARRANTY IS EXPRESSED IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON THE SELLER'S PART AND IT NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR THE SELLER ANY OTHER LIABILITIES IN CONNECTION WITH THE SALE OF THE SAID ARTICLES. This warranty shall not apply to any of such articles which shall have been repaired or altered, except by the Seller, or which shall have been subjected to misuse, negligence, or accident. The aforementioned provisions do not extend the original warranty period of any article which has either been repaired or replaced by Seller.

9. **PAYMENTS** — If, in the judgment of the Seller, the financial conditions of the Buyer at any time does not justify continuation of production or shipment on the terms of payment originally specified, the Seller may require full or partial payment in advance, and, in the event of the bankruptcy or insolvency of the Buyer or in the event any proceeding is brought by or against the Buyer under the bankruptcy or insolvency laws, the Seller shall be entitled to cancel any order then outstanding and shall receive reimbursement for its cancellation charges.

   Each shipment shall be considered a separate and independent transaction, and payment therefor shall be made accordingly. If shipments are delayed by the Buyer, payments shall become due on the date when the Seller is prepared to make shipment. If the work covered by the purchase order is delayed by the Buyer, payments shall be made based on the purchase price and the percentage of completion. Products held for the Buyer shall be at the risk and expense of the Buyer. The Seller reserves the right to ship to its order and make collection by sight draft with bill of lading attached.

10. **GENERAL** — The Seller represents that with respect to the production of the articles and/or the performance of the services covered by this order, it will fully comply with all requirements of the Fair Labor Standards Act of 1938, as amended.

    In no event shall any claim for consequential or special damages be made by either party.

11. **GOVERNMENT CONTRACT PROVISIONS** — If Buyer's original purchase order indicates, by Contract Number, that it is placed under a Government contract, the following provisions of the current Armed Service Procurement Regulation are applicable in accordance with the term thereof, with an appropriate substitution of parties, as the case may be i.e., "Contracting Officer" shall mean "Buyer," "Contractor" shall mea "Seller," and the term "Contract" shall mean this order.

    > 7-103.1, Definitions; 7-103.3, Extras; 7-103.4, Variation in Quantity; 7-103.6, Responsibility for Supplies; 7-103.7, Payments; 7-103.8, Assignment of Claims; 7-103.9, Additional Bond Security; 7-103.10, Federal, State, and Local Taxes; 7-103.13, Renegotiation; 7-103.15, Soviet Controlled Areas; 7-103.16, Contract Work Hours Standards Act — Overtime Compensation; 7-103.17, Walsh-Healey Public Contracts Act; 7-103.18, Equal Opportunity; 7-103.19, Officials Not to Benefit; 7-103.20, Covenant Against Contingent Fees; 7-103.21, Termination for Convenience of the Government — (only to the extent that Buyer's contract is terminated for the convenience of the Government); 7-103.22, Authorization and Consent; 7-103.23, Notice and Assistance Regarding Patent Infringement; 7-104.3, Buy America Act; 7-104.4, Notice to the Government of Labor Disputes; 7-104.11, Excess Profit; 7-104.14, Utilization of Small Business Concerns; 7-104.15, Examination of Records; 7-104.20, Utilization of Concerns in Labor Surplus Areas.

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